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AUGUST 27, 1887.

THE AMERICAN ARCHITECT AND BUILDING NEWS

VOL. XXII. REGULAR EDITION NO. 609.

ARCHITECTVRE

ENGINEERING

DECORATION

CONSTRVCTION

TICKNOR & COMPANY

BOSTON MASS.

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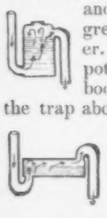
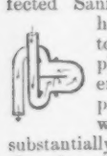
REVIEW OF THE PRINCIPLES OF SANITARY PLUMBING AS NOW ACCEPTED BY ALL LEADING SANITARIANS.

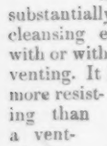
THE main object to be attained is the complete removal of waste matters from the premises the instant they are generated. This can only be accomplished by observing the following rules:—(1.) Avoid all cesspools. (2.) Make all waste-passages as small as possible to effect their purposes. (3.) Construct every fixture on the principle of the flush-tank. (4.) Make every trap seal-retaining and self-scouring. (5.) Make all joints tight. (6.) Select the simplest appliances and the simplest system consistent with safety. These rules are self-evident enough to be accepted as plumbing axioms, and are sufficient to produce perfect work. The "Sanitas" Appliances have been constructed with a view to their fulfilment in every respect, and an examination of the steps leading to the development of these appliances will best illustrate the principles of Sanitary Plumbing, showing the faults which should be avoided, and the objects which should be sought.

Beginning with the trap: In the first place mechanical seals have been discarded as being unreliable, unnecessary, and as obstructing the water-way. We start with the simplest form of water-seal trap, the ordinary S-trap. This

trap answers all our requirements except that it has no power to retain its seal under the variations of atmospheric pressure occuring within the waste-pipes. To remedy this deficiency the pot-trap was developed from the S-trap by simply enlarging its upcast limb, a sufficient enlargement gives it a temporary power of resistance, but creates a cesspool having no self-cleansing power and, accordingly, the trap clogs, under sinks, with grease and ultimately loses its original resisting power. To avoid this difficulty we have turned the pot-trap on its side and reduced the size of its body. This permits the air to pass through the trap above the water without driving the latter out before it, as would be the case with a perpendicular body equally reduced in diameter. To still further increase the power of resistance to siphonage the body was next bent into a quadrangle, giving several reflecting surfaces, which throw back this water under siphoning action while they allow the air to escape, and, finally, the two parallel sides of the quadrangle were merged into a single body having a reflecting partition and a large clean-out cap. This gives us the perfected Sanitas-Trap, which has proved itself to be both anti-siphonic in properly arranged plumbing-work and substantially self-cleansing either with or without venting. It is more resisting than a vented S-trap.







The Sanitas is a Scientific System of Plumbing, having Simplicity and Safety for its Basis. It is also by far the most Economical System

SANITAS

APPLIANCES

PLUMBING

Avoid Infringements and Imitations which are described as being "as good as the 'Sanitas;'" they are not, they are very inferior as well as illegal.

Considering next the Lavatory. These should always be constructed on the principle of the flush-tank, their discharges filling the water-passages "full-bore," so as to keep them clean. The overflow and outlet passages should be combined in the form of a stand-pipe, thus doing away with the usual foul, inaccessible and badly jointed lead overflow-pipe, and the troublesome and dirty plug and chain. The stand-pipe should be operated by a simple mechanism above the slab, for convenience and cleanliness, requiring but a single movement of the hand, and all parts should be of solid and durable construction, while the stand-pipe should be easily detachable for cleansing. The Sanitas Lavatories are all constructed after this principle, and they are the first ever so constructed. The stand-pipes are made of either plated metal or of earthenware, like the fixture itself, and the whole device produces a very ornamental effect, especially when decorated in colors to correspond with the decoration of the earthenware bowl. Finally, the ideal water-closet should have the simplicity of the short-hopper, with the sanitary advantages and convenience of the improved modern closets. More than this, it should be practically noiseless, anti-siphonic, quick-acting, self-sealing, and free from spattering or waste of water. These desiderata have been attained in the Sanitas Water-Closet of which we sketch the outline in section. The supply-pipe between the cistern and the closet discharges into the latter below the level of its standing water, and being without air-pipe, stands permanently full of water, hence the action is instantaneous and the noise of flushing is deadened. This and the peculiar construction of the flushing-rim and water-supply passages cause the waste to be discharged with wonderful speed and effectiveness; and at the same time so quietly that with the cover down and the toilet-room door closed, no sound of flushing can be heard from without. The closet is highly ornamental in appearance, hence no other wood-work is required than the seat and cover, and these may be supported directly on the earthenware itself, which is constructed with this in view. The Sanitas System, taken together, is the most economical as well as the only safe system of plumbing, as avoiding the dangers and complication of special trap venting. Whether vented or not it is now admitted that safety requires a trap to be *anti-siphonic*, the vent-pipe alone not being reliable. The Sanitas Trap holds sufficient water to resist, when properly set, any *back pressure* that can occur in good plumbing with properly vented soil-pipes. For more detailed description and illustration of the Sanitas Appliances, see our other Advertisements and the Circulars of

THE SANITAS MANUFACTURING CO., BOSTON.

T. H. DUGGAN. 141 Dartmouth Street, BOSTON, MASS. TELEPHONE, 4165 Will execute anywhere, in first-class manner, small or large contracts for **PLUMBING**

THE AMERICAN ARCHITECT AND BUILDING NEWS.

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AUGUST 27, 1887.

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AN astounding story comes to us from a place which shall, for the present, be nameless. This anonymous town undertook, not long ago, to build a city-hall. A competition was instituted, into which entered an architect, or firm of architects not very widely known in the profession, but of considerable experience in State and municipal buildings. The work was commenced, and is still going on, but, as usually happens, some one's interest or envy, or disposition to meddle, was the occasion, not long ago, of an investigation by a committee of the City Government, into the manner of conducting it, in which it transpired incidentally that the architects mentioned had before the competition made a contract with an ex-official, promising to pay him fifteen hundred dollars "for his influence in securing the adoption of their plans for the new City-hall by the City Council." Moreover, it turned out that the money had been duly paid. No one seems to have thought much of the matter; but one evening the Committee on Public Buildings and Grounds, which had conducted the previous investigation, took a few leisure moments to satisfy their languid curiosity; and the parties most interested being present, called up the recipient of the fifteen hundred dollars and asked him what he did to earn it. His memory proved weak upon this point, but he produced the contract, which proved to be in the hand-writing of the Mayor. This potentate, being one of the company, explained that he drew up the agreement "in his capacity as a lawyer, and not as Mayor of Anonyma." The Committee then mildly adopted a resolution exonerating everybody from all blame, and immediately elected the receiver of the fifteen hundred dollars keeper of the magnificent new park which forms one of the principal glories of the town.

TO speak with moderation, this case has a strong flavor of the vilest practices known to the architectural profession. Next to tampering with a ballot-box, a crime which, in our humble opinion, should be punished with death, we can conceive of nothing more mean and contemptible than for a man claiming science and skill to enter a contest intended to try the abilities of the participants, in order that the best may be chosen, and try, before the award is made, to corrupt the judges with money and influence. The lowest clodhopper among all our sixty million people would be hooted out of his native town, or dressed in tar and feathers and carried out of it on a rail, if he should enter a race, and hire some one to trip his antagonist, or stand up with the gloves and strike foul blows; yet a man claiming to be a gentleman and an artist can hire a go-between to filch away the prize of fair rivalry from other gentlemen and artists, without, apparently, exciting a single unfavorable remark from the witnesses of his conduct. As to the Mayor who arranged the transaction we have nothing to say, the antics of Mayors being beyond our comprehension; but we would suggest to the tax-payers of the town that a comparison of the sum paid to a single lobbyist for a favorable award with the compensation offered to the successful competitor would be of considerable interest.

THE sad accident in New York, the other day, by which several girls were killed or injured through the rapid descent of an elevator, deserves a little more intelligent attention than the daily papers are able to give it. Probably most architects, in reading the accounts, have wondered at the failure of the safety-catches, made by a firm so highly esteemed as Messrs. Otis Brothers, to stop the car, and, so far as can be judged by the evidence, although a failure of the kind would hardly occur once in a thousand times, this seems to have been the thousandth time. The elevator is said to have been equipped with a safety-catch on a well-known and generally-approved principle, by which the lifting-ropes pass through the "yoke" of the platform, and are attached to the middle of an inverted spring, of bow shape, which is placed on the underside of the timber. The outer ends of the spring move freely, and are engaged with L-shaped levers, the outer ends of which are formed into pawls, shaped to fit the ratchets in the iron guides. So long as the car hangs suspended from the rope, its weight rests on the spring, which is flattened by the pressure, and the ends, being pushed outward, push with them the upper ends of the L-shaped levers, and thus hold back the lower ends which form the pawls. As the car moves up and down, the pawls are, therefore, maintained a fraction of an inch away from the ratchets, but ready, if the spring should be released by the breaking of a rope, to dart instantaneously into their places and hold the car safe. If the rope of the New York elevator had broken, this would have been the effect, the spring instantly assuming its normal form, and throwing out the pawls so as to stop the car. Unfortunately, it did not break, but one or two teeth of the pinion, by which the rapid motion of the shaft is transformed into the slow movement of the winding drum, broke off. This left the drum free to turn the wrong way, and it did so, allowing the hoisting-rope to uncoil, and the car to descend. If the drum had broken itself entirely loose, it would probably have turned so freely as to relax the spring and throw out the pawls, but the obstruction caused by the fragments of the pinion, the dragging of the rope, and, perhaps, the friction of the brake which is usually provided for use in certain contingencies, seems to have checked the descent so much as to keep the car pulling strongly on the rope, thus flattening the spring, and preventing the pawls from flying out. It is obvious that the spring must be so adjusted that the relaxation due to the normal downward movement shall not operate the catch, and in this case the speed of descent, although great enough to be fatal, remained just within the margin necessarily left to prevent heavy loads from being caught in the midst of the downward journey.

THE people of Ohio propose to hold an exhibition in Columbus, the capital of the State, in September, 1888, to celebrate the one hundredth anniversary of the settlement of the State. Among other things, works of art are to be exhibited, and the directors invite contributions from all quarters. The arrangements made for this department are very liberal. Agents are to be appointed in Boston, New York, Philadelphia and Chicago, to collect pictures and statues, and those approved will be packed, transported to Columbus, insured and returned, free of expense to their owners, while works for sale will be shown by a competent person, and sold, if possible, without charge for commission. The directors point out that two-thirds of the people of the Union live within one day's journey of Columbus, and if the exhibition is as good as it seems likely to be, it ought to have many visitors. Architectural designs, sketches and photographs are particularly invited, and it is to be hoped that many will be sent. If we may make a suggestion, we should like to see a special exhibition of photographs of buildings. It must be confessed that collections of architectural drawings do not attract many people out of the profession, and even in Paris and London the architectural rooms at the *Salon* and the Royal Academy are deserted, while the adjoining apartments, hung with ordinary pictures, are crowded. A collection of photographs of architectural subjects would be a novelty in exhibitions. We know that most photographs of buildings taken in

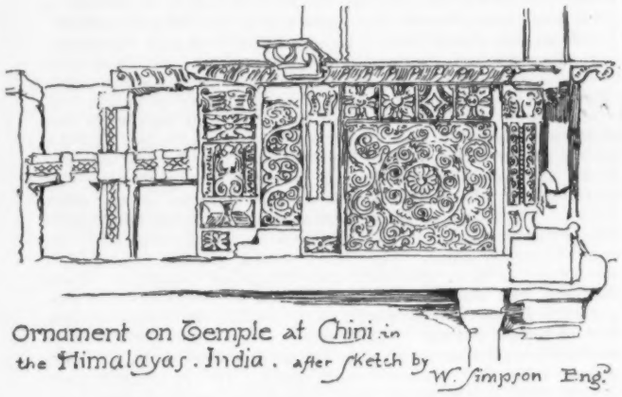
this country are very bad, presenting generally a distorted view of the least interesting portion of the structure, without contrast of light and shadow, and with no attempt at preparing the building for its picture; but the idea of showing them would encourage architects either to take views of their own work, or to direct the photographer deputed to do so; and an immense amount of interesting material, particularly in the shape of detail, might be secured in this way which would never be shown in drawings. Those persons, either artists or architects, who are disposed to contribute, may obtain information desired from the Commissioner, Mr. Walter S. Goodnough, 101 Hamilton Avenue, Columbus, Ohio.

BUILDERS may be interested to know the items of cost of a small Paris house, which we find given in detail in *La Semaine des Constructeurs*. The house is one of two, which form the end of a block in a good quarter of Paris, and the design, by M. Renault, seemed so pretty to M. Noé, the skilful sketcher whose drawings beautify that excellent journal, that he has given them both, with the plans of the two principal floors. The lot on which each stands covers about a thousand square feet, being some twenty-four feet wide by forty-five deep. The building is about twenty-five feet deep, leaving a garden — not a "back yard,"— twenty by twenty-four, which is laid out in tiny walks and flower-beds. The entrance door is nearly in the middle of the front, and opens into a hall, about four feet wide, which extends to the dining-room door. On one side of the hall is the parlor, about ten feet by fourteen, with a fireplace in it, and on the other an office, about seven by eight feet, with a corner fireplace, and beyond this the stairs, which go up at right angles with the hall, as is often the case in our city houses. At the foot of the stairs is a little free space, into which open both the parlor and dining-room doors, while the door to the kitchen, which adjoins the dining-room, opens into the same place, but is retired somewhat under the stairs. The dining-room and kitchen occupy the whole of the garden front, the former being about as large as the parlor, while the kitchen is about eight and one-half by ten feet, which is a tolerably good size for a French kitchen. A casement window opens from the dining-room to a flight of steps descending to the garden; and the kitchen has also a small flight to its own corner, besides stairs to the cellar, going down under the main stairs. The second story has two large bed-rooms and two small rooms, and a water-closet, lighted from the outside; and the third story, in the Mansard roof, presumably about the same accommodation. All of the large chambers, besides the dining-room, parlor and office, have open fireplaces. Each house is prettily treated in brick and stone, with stone cornices, and a good deal of carved stone detail; and the cost of each, complete, was less than five thousand dollars, exclusive of the land. It must be remembered that building is very expensive in Paris, and the work could probably have been done here with less cut-stone, but more elaborate woodwork, for the same amount, or less, but few of our city houses can show as compact planning, or so many pleasant rooms for so small a sum. In Paris the expense was increased by a bad foundation, which required two hundred and thirty-six dollars' worth of "consolidation" for each house before it could be built upon. Independent of this, the excavation cost fifty-six dollars, the mason-work and tile floors two thousand and fifty; the beams and framing three hundred and twenty; the roofing, gutters, plumbing and gas-fitting three hundred and thirty-eight; the hardware, including pretty iron balconies to two of the front windows, four hundred and eighty-six; the joinery six hundred and eight; the mantels ninety; the fireplaces and range two hundred and twenty; the drains eighty-six, the bells thirty-two; the Venetian blinds fifty-two, and the carving sixty-eight.

IT is very pleasant, as well as encouraging, to find one's work appreciated, and we are glad to call the attention of our younger readers to the praise bestowed by so brilliant a journal as *La Semaine des Constructeurs* upon Mr. Harold B. Warren's beautiful pen-and-ink drawing of the grand staircase of the Examination Schools building at Oxford, which appeared not long ago in the *Sanitary Engineer*, and is reproduced as a full-page illustration by the French journal. Although Mr. Warren is an artist, not an architect, he is quite familiar with architectural drawing, and has distinguished himself by his sympathy with such subjects; so that it is not surprising to find the sketch, although treated with a skill in light and shade which marks the trained artist, full of that feeling of solidity, and comprehension of structure which architects like to impress upon their drawings. The staircase itself is, perhaps, the crowning beauty of one of the most interesting of modern buildings. Entering by the central door, the visitor finds himself in a hall, not very vast in dimensions, but made picturesque by a balcony on one side, while the construction, all of solid, cream-white stone, gives it a peculiarly satisfying effect. At one end of the hall is the staircase, also of stone, ascending to an arcaded corridor, which communicates with the various examination-rooms. The disposition is simply the common one, of a fireproof hall in two stories, opening in each into rooms of wood-construction, but carried out in the noblest spirit. The stairs themselves are, of course, stone, ascending by several turns, with square landings, in the free, picturesque manner which characterizes the building; and the balustrade, instead of imitating the wreathed ironwork of a French stair, or the Classic balusters of an Italian one, consists of a series of panels, alternately large, pierced with a pretty pattern, and small, containing plates of precious marble. To prevent the panels from looking "spotty," a band of colored stone is carried along the whole length of the balustrade, just beneath them, moulded to form a plinth, and dark-marble shafts carry the arcade above. This gives effect enough to support strong color in the panels, and it is freely used, one panel, in particular, containing a magnificent piece of blue Labradorite. The whole, though not more costly than the staircases of many of our office and bank buildings, has an interest seldom found in such structures, and is well worth studying.

THE *Sanitary News* makes a good suggestion in regard to the construction of public buildings, which, in this country, are almost invariably remarkable for the disregard shown in them for the simplest rules of health. As the *Sanitary News* says, this is to be attributed in a great degree, perhaps principally, to the cleverness of Legislatures, which delight in uniting a long list of requirements for such buildings with an appropriation which they know to be inadequate, apparently under the idea that some one will be thus deluded into signing a contract to do the work at a loss. Unfortunately for this idea, architects and builders usually know quite as much of their own business as legislators do, and those, particularly, who care to meddle with public buildings have brought the art of getting over work cheaply, in case of need, to a perfection which leaves little to be desired; and the announcement of a programme for a building which ought to cost a million dollars, but the expense of which is restricted by law to half that amount, gives them just the opportunity they need — not for sacrificing themselves as victims either to legislative astuteness or their own public spirit, but for making a good deal of money out of a contract which would ruin men more scrupulous or less ingenious. The most vigilant supervision of a large building is ineffectual against a determination on the part of an experienced contractor to scamp his work; and architects as well as sanitary engineers have plenty of stories to tell about the abominations which are frequently disclosed by expert examination of the most costly structures. Some of these, which are inherent in the plan, and are due more to the hurry of a cheap and underpaid architect to get over his work with as little expenditure of time and study as possible than to premeditated malice, may easily be detected by experts; and a statute of Michigan provides that all plans for the alteration or construction of public buildings shall be submitted to the State Board of Health, and approved, before being carried into execution. With such excellent Boards of Health as are found in most of our States, this rule would be of great value; and, if it were possible, we think that all school-houses, both for public and private schools, and all hospitals, whether maintained at the public expense or by private subscription, should be included among the structures which it should be forbidden to erect until the plans for them had been examined and approved by the highest sanitary authority of the State. In the older States, particularly, the condition, even of public school-houses, is sufficiently disgraceful, but many private schools are held in rooms which would not be tolerated in public school-houses in the same locality; while, as medical men can testify, a great deal of money is just now likely to be worse than wasted on small hospitals which lack the first requisites of such buildings, and, when they get older, will cause quite as much sickness as they will cure. Nothing but supervision of the plans will correct this, and such supervision should be made compulsory.

THE MEXICAN NATIONAL LIBRARY.



THE "Reform" in Mexico, as it is called, is a chapter in Mexican history generally very little understood. This is not the place to attempt a full explanation of it, but a brief statement of the facts in the case, as suggested by the building now used as the National Library, may not be out of place. In 1859 Benito Juarez became the "Constitutional President" of Mexico (as he is always called), by means which, though interesting, are too complicated to be related here. There was another president — or anti-president as he is now called, since the cause of Juarez triumphed in the end — at the time in possession of the capital, and after various attempts to establish himself elsewhere, Juarez finally formed a home for his Government in Vera Cruz. The anti-president in the city of Mexico was under the control of the Church, and his Government derived its support from the Church. Such were the circumstances, under which Juarez, the plucky little Indian who had risen step by step from a mean birthplace in an Indian hamlet in the mountains of Oaxaca to the presidential chair, issued a decree "Nationalizing" — that is confiscating all the property belonging to the Church, and suppressing all monastic orders throughout the country. It seems strange that such a measure should be so widely regarded as a Protestant triumph over Romanism. Juarez was not a Protestant Christian. He was not aiming a blow at Romanism as distinct from Protestantism or Judaism. He hated the Church, that was all. He hated any institution that held money which would be useful for the carrying on of his Government, and more than all he hated any institution that supported a Government in opposition to his, and occupied the capital to his exclusion. He fought, not Rome in particular, for he knew no other Church, but he fought Christianity. His feeble and indirect encouragement of Protestantism was because he saw in it, as he supposed, an enemy of the established religion. In his eyes Protestantism was a modified form of infidelity.

It is the result of the "Reform" laws of Juarez upon the architecture of Mexico that attracts the attention of many visitors to that city. Juarez managed to overthrow the rival Government in the capital and fight his way up to the city of Mexico. There, in the most brutal manner, the "Reform" laws were executed. The monasteries were closed and dismantled. Everything that could be quickly converted into money was taken. Thus plate, jewels and paintings were removed. Altars were destroyed and bells taken from towers. Twenty millions of dollars are said to have been realized by these measures. And yet the Mexican Government remained as deeply in debt as before. The property was turned over to secular uses. That is why one may see in the city of Mexico (the blow fell heavier upon the Church in that city than elsewhere), so many buildings bearing crosses, sacred monograms and other marks and symbols denoting that they once belonged to the Church, but which are now devoted to secular, not to say in some cases, *base* uses.

Among the monasteries undergoing this experience in the Mexican capital was that of San Agustin. The order of San Agustin came to Mexico in 1533, and shortly afterwards built a church which was destroyed by fire in 1676, and immediately afterwards the walls of the present building were erected upon the same site. When the fury of the "Reform" broke upon the Church in the capital, San Agustin was dismantled and gutted. A beautiful choir, of the form of that now existing in the Cathedral, which had cost upwards of two hundred thousand dollars was sold for three thousand dollars. The towers were destroyed. After the restoration of the Republic, upon the defeat of Maximilian and the Imperialists, it was decided to found a National Library in Mexico out of the spoils from the several monasteries, for these monasteries had been rich in literary as well as art treasures, and what else could the Government do with the thousands of volumes in vellum binding? The Church of San Agustin was selected as the most suitable to be made the permanent home of this library. Thus in the words of an indignant priest of my acquaintance, "The Mexican Government robbed the Church of buildings and of books, and putting the latter into one of the former, founded the *Bibliotheca Nacional* (National Library), and got the reputation of being the patron of letters and of encouraging literature."

The building was adapted to its present use at considerable expense. The exterior of the main building, seems by careful comparison with an old print in my possession, to have undergone no less changes than the interior. The basso relievo of the patron saint over the main entrance is all that remains to indicate that the building was once a church. A chapel of the *Tercer Orden* (Third Order, — lay members of the order) older than the church, in the rear of the main building, remains about as it was, having survived the fire which destroyed the first church, and also the devastations of the "Reform." It is a quaint bit of architecture, a Greek cross in form, and is made a sort of lumber-room for unclassified books. The library itself consists of about one hundred and fifty thousand books. It is rich in every department of literature, though naturally strongest in theology and colonial history, owing to its original source.

In a niche where was once a side entrance to the church, stands a large statue of Minerva. The library contains sixteen noble statues of colossal size, intended to represent the Fathers of Learning. They include Confucius, Homer, Plato, Aristophanes, Cicero, Virgil, Isaiah, St. Paul, Origen, Cuvier, Humboldt, and others. The grounds about the building are beautifully laid out. The posts of the iron railing surrounding the whole are surmounted by busts of Mexicans celebrated in the field of letters or science. There are nineteen. They include the celebrated Aztec poet Netzahualcayotl, and Aztec historian Ixolilxochitl, thus testifying how intensely *Mexican* the Mexicans are in their tastes and sympathies.

A block beyond the National Library on the opposite side of the street is a building which escapes the attention of most tourists, though it deserves some notice. It is a plain building now occupied as a storehouse by a mercantile concern. Its front wall is marked by a marble slab, "To the memory of Alexander Von Humboldt who lived in the house in the year 1803." The slab was inserted in the wall "on the one hundredth anniversary of his birth, September 14, 1869, by the German residents in Mexico." But this tribute to the memory of Humboldt is not characteristic of the Germans alone. The Mexicans are fond of his memory, and many are the means by which they seek to testify their appreciation of his interest in their country.

ARTHUR HOWARD NOLL.

HOW WE SHOULD PLACE OUR HOUSES.

IT was Karl Vogt, the eminent scientist of Geneva, Switzerland, who, by experiment, established the fact that, leaving the north side of a building out of the question, the south side is found during the summer months to be always the coolest, the east side following next in degree of temperature, while the west side he found to be the warmest. The direct effect of the solar rays upon the eastern and western walls of a house he found to be greatly stronger than upon the southern walls, this difference being accounted for by the different angles of incidence of the solar rays falling upon the walls. On the east and west sides, the said angle reaches its maxmimum size of ninety degrees, while the south walls are struck at an acute angle, hence the effect is much slighter. Vogt for the first time called attention to the problem of computing scientifically how our dwelling-shouses should be placed to insure for them a sufficient quantity of solar heat and light. Although the idea would not seem to be of much practical value, when applied to our customary city dwellings, surrounded, as they are, by other buildings, it must be conceded, that in its application to detached dwellings, it is deserving of careful consideration at the hands of the professional architect.

As long as nineteen hundred years ago, Vitruvius, the Roman architect, laid stress on the principle that, in planning cities the streets must not be laid parallel with the direction of the prevailing atmospherical currents. In Germany, the prevailing currents are north-east and south-west; hence her towns, if laid out on the rectangular plan, should have streets running from east to west and from north to south. This plan has actually been followed in a number

of cases, for instance, the cities of Karlsruhe, Mannheim, Darmstadt and others. Supposing a house so placed, it is evident that the prevailing north-east winds must strike the sides of the house at angles of incidence averaging forty-five degrees. Other winds striking the walls squarely or nearly so, are usually of short duration, blowing only for a few hours at one time.

It will be observed that, if we locate our houses on the principle advocated by Virtuvius, we are, at the same time, fulfilling the requirements demanded by Professor Vogt. During the summer months, the sun rising in the north-east and setting in the north-west, the east and west walls of a house will be heated to a greater, and the south wall to a lesser degree, since the rays of the sun then being at its great declination, fall more obliquely upon the latter than they do upon the former. On the other hand, during the winter months, the sun rising in the south-east and setting in the south-west, it is the south wall which is exposed to rays thrown upon it almost at right angles by the sun which then is at its minimum declination, whilst both east and west walls receive oblique rays only. Hence, if your house is so planned, that one side greatly exceeds in length the other, place its long side on a line running from east to west to insure for the same greater warmth in winter and less heat in summer, whilst the short side can better afford to be the cooler side in winter and the hotter one in summer, just because it is the shorter side.

It may be objected that, as there will be a long side combining the advantages of its southward position in hot and cold weather, so will there be a correspondingly long northern side receiving no sun during any time of the year, besides offering an extended surface to cold north-easterly winds. To this we answer, that it is impracticable to devise a plan that will combine all the advantages sought. By placing a rectangular house with its long side running from south to north, a more uniform distribution of the heating effect of the solar rays, and the different sides, may perhaps be obtained in winter, but — and here we have to touch upon another important factor governing the designing architect — the long side of the building so placed would then receive a much smaller amount of light than it would get by facing south.

It is, therefore, the desire to obtain the greatest possible amount of sunlight which causes men to place the long sides of their houses so as to face south, and thus to instinctively obey the law discovered by the scientist. In one class of buildings, the noblest one — churches, this rule has from olden times been recognized and strictly adhered to. Since man began to erect houses to God, up to the churches of the present day, it has been the favorite plan to build these edifices running from east to west. We are well aware that archæologists and art-critics have tried to explain this custom as emanating from a desire to place the altar nearest to the rising sun. But this motive alone would scarcely have asserted itself so continuously for centuries, had not the necessity of supplying churches with the greatest amount of light obtainable, caused that favorite plan to be adhered to. Thus, early religious sentiment and everyday practical need have combined to establish the rule, observed ever since, in locating churches, and the same rule, viz., that their long sides should face south and north respectively, should, wherever possible, be observed in the planning of our dwelling-houses. — *Heinrich Becker in the Deutsche Bauzeitung.*

PARIS CHURCHES.[1] — V.

ST. GERMAIN L'AUXERROIS.

From la Revue des Arts Decoratifs

BETWEEN the years 420 and 430 the ancient British church became infected with the heresy of Pelagianism, and the orthodox clergy, being unable to stay its progress, sent to Gaul desiring assistance. Thereupon a synod of the Gallican church was held, and it was determined to send Germanus, bishop of Auxerre, and Lupus, bishop of Troyes, to confute the heretics. The date assigned to this event by Prosper, a contemporary writer, is 429; but he makes no allusion to Lupus, whose participation in the mission rests upon the evidence of Constantius of Lyons, the biographer of St. Germanus. This Lupus was the author of "*A Defence of the Catholic Faith*," a book which was of much use to Cranmer and Ridley at the time of the Reformation. The meeting appointed for the public disputation with the Pelagians is supposed to have taken place at Verulam (now St. Alban's, Hertfordshire), in 429; and according to the Venerable Bede's account, the heretics came to the council in great pomp, and advocated their cause with much "inflated rhetoric." But to no end. Germanus and Lupus silenced them with overwhelming arguments, and they were utterly discomfited. Bede's account is so quaint, and shows so great a difference between a fifth and a nineteenth century council, that it is worth while to quote it in full. "An immense multitude was there assembled with their wives and children. The people stood round as spectators and judges; but the parties present differed much in appearance; on the one side was divine faith, on the other human presumption; on the one side piety, on the other pride; on the one side Pelagius, on the other Christ. The most holy priests Germanus and Lupus permitted their adversaries to speak first, who long took up the time and filled the ears with empty words. Then the venerable prelates poured forth the torrent of their apostolical and evangelical eloquence. Their discourse was interspersed with scriptural sentences, and they supported their most weighty assertions by reading the written testimonies of famous writers. Vanity was convinced, and perfidiousness confuted; so, that at every objection made against them, not being able to reply, they confessed their errors. The people, who were judges, could scarce refrain from violence, but signified their judgment by their acclamations."

It is worth noting that at this time the *people were the judges in matters theological;* rather a different state of things from that which is now the custom at Rome and other places. After this, Germanus and his companion seem to have helped the Britons in a war against the Saxons and Picts, and by a simple stratagem routed the enemy. Germanus assembled the British troops in a hollow, surrounded by hills, and enjoined his followers to shout "Alleluia" three times. This they did, and the echo taking up the sound, produced such an effect upon the enemy that they took flight for fear of the multitude which they thought had come out against them. This "Alleluiatic Victory" is related by Constantius and Bede, and in later times by Fuller, but some authorities doubt its truth. At the same time the neighborhood of Mæsgarmon, in Flintshire, where the battle is supposed to have been fought, retains names of places which seem to have some connection with the memory of St. Germanus. After this victory the good bishop returned to his own country, but in 447 the Pelagians again becoming aggressive, he took a second journey to Britain, and this time not only baffled the heretics, but banished them. Germanus seems to have reformed the British Church, and modelled it upon the Gallican; for it was about his time, and no doubt, through his influence that parochial churches were founded in country places; the rural populations having previously depended upon missionaries from the towns for their spiritual teaching. Germanus also established schools of learning in Britain, and is thought by some persons to have introduced the Gallican liturgy. During the Roman occupation of Britain there were professors of Greek and Latin in all the chief cities of the country; but after the withdrawal of the Roman forces it became difficult to keep up these professorships. Hence the foundation of schools of learning, otherwise monasteries, was suggested by St. Germanus; and to this end he consecrated Dubricius, archbishop of Llandaff, and Daniel, bishop of Bangor. The former founded colleges at Hentland-on-the-Wye (where he had a thousand pupils), and Llancarfen, or Llanfeiltrin, Caerworgorn, and Caerleon. The word *bangor* in Welsh is simply a name for any college, and towards the end of the fifth century all the Christian societies began to assume that epitaph, *ban*, high, *côr* circle or congregation. The word is written variously (in MSS.), Ban Cor, Banchor, or Bangor. Bangor Garmon, or the College of Germanus, at Llanveiltrin, in Glamorgan, was founded by him in 460. Little is known of the internal regulations of these colleges, but the discipline instituted by St. Columba, about a hundred years later was very severe. Religious offices were held three times during the day, and as often during the night. Each day office consisted of prayers and three psalms, and in the night ones, from October to February, the monks were to chant thirty-six psalms and twelve anthems. That St. Germanus was a remarkable man there is no doubt, as we also owe the discovery of Ste. Geneviève to his foresight; for, when he saw her at Nanterre, on his way to Britain, he was so impressed by her piety that he consecrated her to the service of God.

The church in Paris was probably founded in commemoration of some miracle performed by the bishop during his sojourn in that city; or in his memory, which was held in great esteem by his namesake, St. Germain de Paris. That its origin is very early is certain, as we find that King Childebert and Queen Ultrogothe enriched it with gifts of various kinds. This early church was probably circular, as it was then called St. Germain le Rond; but in 886 it was utterly destroyed during the Norman invasion. It was in this first church that St. Landry, bishop of Paris, was buried. Originally, a chapter composed of a dean, a singer or precentor, thirteen canons, and eleven chaplains served the church, and it ranked immediately after Notre Dame, to which it was affiliated in 1744. Since that time it has been only a parish church.

Near the church are the Quai and Place de l'École, which owe their names to a public school of great celebrity, which was established about the time of Charlemagne. The church was rebuilt by King Robert, and again in the twelfth century it was entirely reconstructed. In 1831 it was so disastrously "restored" that half its original beauty has departed, although a later restoration has, to a

[1] Continued from No. 586, page 136.

certain extent, rectified the damage done by the nineteenth-century Vandals.

The tower is all that remains of the twelfth century; the principal door, the choir, and the apse are of the thirteenth; the porch, the greater part of the façade, the nave and aisles, and the chapels of the *chêvet* are of the fifteenth and sixteenth century. The cloister which surrounded the church has disappeared, as also the dean's house which stood in the space between the church and the Louvre. It was in traversing the cloisters of St. Germain that Admiral Coligny was shot, and it was the great bell of the church which gave the signal for the massacre of St. Bartholomew. St. Germain was the parish church of the Louvre and Tuileries, and many of the royal children were baptised there; while the kings went there in great state to perform their paschal duties.

The portico projects in front of the three principal west doors, and is the work of Master Jean Gaussel. It was constructed in 1435, and it is a mass of very beautiful carving. Some of the corbels are examples of the grotesque imagery of the period. The interior was decorated with frescos some years ago, but they are in a dismal, peeling condition. The central doorway is of the thirteenth century; the two side ones are of the fifteenth century. The whole is decorated with statues of various saints — amongst others St. Germain, St. Vincent, and Ste. Geneviève holding her candle, which a hideous little demon is trying to blow out. Round the tympanum, the subject of which is the Last Judgment, are the Wise and Foolish Virgins, the Apostles and the Martyrs. Abraham sits on one side holding a napkin on which are three little souls; while on the other is an infernal cauldron containing three lost souls (one mitred), and two horrible demons — one tormenting a soul with a whip, the other throwing a poor creature into the flames, having already torn his flesh into shreds. The gargoyles are peculiarly grotesque: a grinning savage is being ejected from the jaws of a hippopotamus; a man carries a hooded ape on his shoulders; and a showman is making a monkey dance. A corbel shows us a quantity of rats persecuted by a cat — the rats being the wicked who are consumed by the demon.

The exterior of the apse is disfigured by an arrangement of late date, a series of little rooms built of wood, and placed in front of one entire window, a wooden staircase leading up to them. It is an extraordinary fact that such a disfigurement to a church should have been allowed, and that Catholics do not protest against the profanity, as well as the Vandalism that permits the erection to remain.

The interior of the church has been all but ruined by the "restoration" of 1831. The old columns were fluted after a Classic pattern, the mouldings of the capitals being destroyed, and converted into garlands or festoons of flowers. The arches were disfigured as much as possible, and the whole nave deformed into a Classic affair. The only part which remains in its original condition is the apse, with its chapels, and the chapel of the Blessed Virgin. The latter is a gem, with its clustered columns and foliated capitals.

Formerly the choir was enclosed by a splendid *jubé*, the combined work of Pierre Lescot and Jean Goujon. Portions of the bas-relief of this — "The Entombment," and the "Four Evangelists" — are in the Renaissance Sculpture Museum of the Louvre. Had the modern possessors of the church only pulled this down they might have been forgiven, but they did not rest until they had appointed Bacarit to "purify" the church of its *barbaric Gothique*. Unfortunately for the reputation of the Academicians of 1745, we, in these days, can only look upon *their* transformation as far worse than barbaric.

The chapels of the *chevet* have niches in the wall surmounted by round-headed arches and containing statues. There are in all thirteen chapels, but some of them now form the sacristy and the north door, the exterior of which is a good specimen of Renaissance work. Of the old glass little remains earlier than the fifteenth and sixteenth centuries. I imagine the good "artists" in 1728 scraping the paint off the vaulting and taking out the stained glass to make the church lighter! But happily the rose-windows of the two transepts, four lights of the south aisle, and two of the north aisle still remain; but these are only of the sixteenth century, and consequently are not in the best taste. Some have Gothic and some Renaissance surroundings, but the color is, if rather bright, clear and rich. Unfortunately, time has obliterated many of the heads and hands; but enough remains to read the subjects. There are a great many modern windows, but except those in imitation of the ones in the Ste. Chapelle, by MM. Lassus and Didron, they are of little artistic value. M. Lassus was the architect who superintended all the later restorations and decorations.

The chapel of the Blessed Virgin is a little church in itself, with stalls, organ, pulpit, screen and altar, all richly decorated. The reredos is a tree of Jesse which surrounds the Virgin with its branches. This is in stone, of the fourteenth century, and comes from a church in Champagne. Some restorations in 1738 brought to light a curious sixteenth-century wall-painting, representing a cemetery with the graves giving up their dead to the sound of the angels' trumpets. Three statues were also found of the same date as the chapel, and serve as the retable of the altar: they represent the Blessed Virgin sitting, and probably St. Germain and St. Vincent (who are united in all the decorations of this church), standing on each side of her. The *banc d'œuvre*, which is a sort of pew in front of the pulpit for the clergy during sermon, was executed in 1684 by Mercier, from drawings of Lebrun. It is handsome in its way, but utterly out of keeping with the rest of the church. It is composed of Ionic columns supporting a huge baldachino; and probably looked its best when it was filled by royal personages on high festivals and state occasions.

Amongst a crowd of courtiers and statesmen were the tombs of Malherbe, the poet, André Dacier, the *savant*, the painters Coypel, Houasse, Stella and Santerre; the sculptors Sarazin, Desjardins, and Coyzevox; the medallist Warin, the goldsmith Balin, the engraver Sylvestre, the architects Levau and Dorbay, the geographer Sanson, and the Comte de Caylus; but all these have disappeared. Of those which remain are two chancellors of France, Magnier, who died in 1635, and d'Aligre, who died in 1677; two statues which come from the mausoleum, which the house of Rostaing formerly had at St. Germain's; the epitaph of a Mortemarte, Duchess of Lesdiguières, who died in 1740, and a few modern ones of no value. But the grandest tomb is that which Charles V erected to the memory of his jester. Sauval speaks of this as grander than that of Du Guesclin at St. Denis. The pedestal was of black marble supporting a recumbant figure the size of life; the hands and head were of alabaster, the body of white marble, painted. It served as the model of the tomb erected by Hennequin de la Croix in 1375 to another jester, Thévenin, in the church of St. Maurice de Senlis; but both have been destroyed. A few fragments of the many monuments which the church formerly contained may be seen in the Louvre.

In conclusion, I commend to the notice of students some of the capitals of the south aisle of the nave, and the corbels and brackets of the porches. As examples of the quaint, grotesque tastes of Mediæval sculptors, they are unique. Verily, those early artists were humorists of the first order; but unfortunately, like their brethren of the pen, they often spoiled their work by indulgence of their taste for coarse and gross jokes.

S. BEALE.

ASPHALTE PAVING.

The Turret Stair.
Naworth Castle, Cumberland, Eng.
From The Building News.

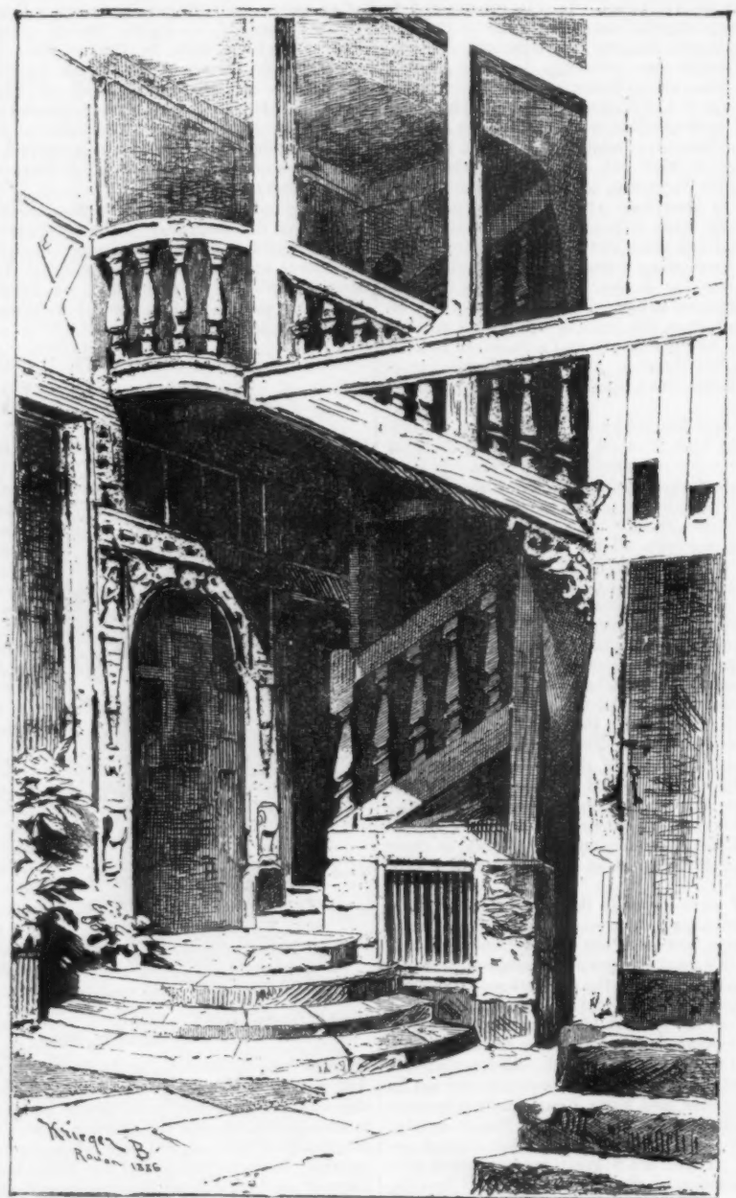
THE following extracts are taken from a paper by Mr. G. B. Strachan read at the recent Congress of Municipal and Sanitary Engineers, at Leicester, England.

In Chelsea there are 16½ miles of footways paved with mastic asphalte, having an area of 68,290 square yards. On the Queen's Park Estate there are 41,500 square yards, which have been laid five years, and which are now in good condition, not having cost one penny for repairs. In King's-road, at Walpole street, a length has been laid for seven years. The foot traffic over it is 7,500 persons in eighteen hours. At the end of the first five years it was cut open, and the wear was found to be such as had reduced the thickness to a spare ⅞ of an inch, the original thickness being 1 inch full. On the east side of New Bond street a length of mastic asphalte was laid thirteen years ago between Oxford street and Conduit street, the thickness being ¾ of an inch. The asphalte is now wearing through onto the concrete in the line of traffic at the forecourt line. The cost for repairs has been so trifling that it may be neglected. In this case the concrete foundation is as sound as before, and all that is necessary to restore the footway is to relay the asphalte at about two-thirds of the original cost, when the pavement will be good for another thirteen years. As the traffic here is very severe and the footway narrow, it is reliable evidence of the durability of asphalte.

The foundation for the asphalte footway is made with 3 inches of Portland cement concrete (6 to 1) of a very good quality. The surface is smoothed with the shovel, and four days are allowed for drying. The concrete has been laid hitherto without any joints. The mastic asphalte is floated over this surface, and the path is then completed. Mastic asphalte does not show any cracks on the surface. The concrete foundation, when the asphalte is removed, shows the irregular, tree-like cracks all along its length, branching from the curb to the back line, but the elasticity of the mastic asphalte is sufficient to resist the tearing action of the concrete as it contracts.

A study of the asphalte question resolves itself principally into a study of the movements of concrete when laid in long lengths, narrow widths, and small thicknesses. The writer inclines to the opinion that concrete has in itself a small power of contraction, apart from any considerations of temperature. The experiments of Dyckerhoff which show that neat cement (slow setting) had an average expansive power over twelve months of .0734 per cent, and

quick-setting cements of .2019 per cent, and that concrete (3 to 1, sand) had an expansive power of .0264 per cent (slow setting) and .0320 per cent (quick setting), seem to show the contrary to be the case. The writer laid down a length of concrete (6 to 1, ballast) 52 feet long, 12 inches wide, and 3 inches thick, under a shed which had an open front, but so that the sun did not touch the concrete. The strip was laid on sand so as to give it freedom of movement. Another strip 26 feet long, of the same width and thickness (3 to 1, pebbles), and a third of the same dimensions (3 to 1, sand) were also laid under the same conditions. The only movement discernible, at the end of one month, was a slight contraction in length in all the samples. The uniform experience of concretes under asphalte is that cracks occur, which would tend to show that contraction and not expansion is the rule. At the same time, the writer has experience that concretes do expand, but this he attributes to the action of temperature. It is no uncommon thing to see the surface of an asphalte path raised crosswise in an irregular line, as though a small tree root were under it. In every case where the asphalte has been uncovered at these points by the writer, he has found the concrete crushed and the concrete on the falling level thrusting itself under the concrete on the rising level. This effect is most marked on hot days. In January last the writer laid some thousands of feet of asphalte path in St. Luke's Gardens, Chelsea. The sun is on it all day, and during the hot weather at the beginning of June, the number and size of these raised lines was astonishing. Shortly after midday they were most pronounced, and towards night they were less prominent. As a further evidence of the expansion of concrete under the sun's rays the streets in the City can be named. The footway and carriageway are in asphalte on concrete. The expansion of the concrete in the carriageway presses the curb at the bottom; the expansion of the concrete in the footway presses the curb at the top on the opposite side, and the two have tilted up the curb in a marked manner. The writer has on a hot day taken up asphalte on a footway and has found the heat much greater under the asphalte than on the surface. In order to avoid the expansion showing itself in footways the concrete should be laid in sections, and the joints between them filled with some compressible substance.



STAIRCASE ROUEN FROM THE MONITEUR DES ARCHITECTES

Compressed asphalte has about one-third longer life than mastic asphalte under the same conditions. The cost is the same, but the use of compressed asphalte for this purpose has not been universally followed by reason of the cracks that appear on its surface. The cracks do not tend to spread under traffic, nor does the asphalte wear more at these parts than at others. They are unsightly, however. It is found that these cracks are exactly of the shape and in the position of the cracks in the concrete foundation. Compressed asphalte has no elasticity in itself, and when subjected to the contracting force of the concrete it is torn through. It is an admirable tell-tale of the movements of the concrete. Much ingenuity has been displayed in endeavors to avoid the cracks. The first step was to localize them. This was done by laying the concrete in 12 feet bays and in alternate bays, and filling up the screed space with fine concrete. The contraction then showed its effects at these places, with the result that a series of regular straight cracks appeared instead of the irregular tree-like cracks when the concrete was laid in one piece. These effects can be seen at many places in London, without specifying any particular place. Having localized the cracks, an experiment was made at Hornsey to avoid them. A strip of bituminous felt 6 inches in width and $\frac{3}{4}$ inches thick was placed on the concrete over the whole length of the screed mark. This felt has much elasticity, and the object of the experiment was to ascertain whether it would take up the contracting movement of the concrete and absorb it. The length is laid at Crouch Hall road, between Coolhurst road and Clifton road. The result has been that, instead of one crack at each screed mark, there are two, one on each side of the narrow strip of felt. It is evident that the concrete in contracting compresses the asphalte longitudinally, and that the cracks appear at the points where the opposing motions meet; and as the strip of felt represented a narrow area which was free from these forces, a crack appeared on each side where the forces took effect. In Archway road, Hornsey, another experiment was made by covering the screed mark with a strip of mastic asphalte 9 inches in width and $\frac{1}{8}$ inch thick, just as in the last case with felt. For three months no cracks appeared; then a few, slowly and at irregular intervals, showed themselves; but during the severe winter of 1886-7 every screed mark showed its crack. These cracks were irregular in line, but they are confined in each case to the area covered by the mastic asphalte. These footways are laid on a 3-inch foundation of concrete. In Marlborough road, Chelsea, an experiment was made on different lines. A foundation of concrete 6 inches thick was laid, and the compressed asphalte laid on it. For four months no cracks appeared, but after that time they occurred at frequent intervals, though they are fewer than usually appear on a 3-inch foundation. When the asphalte and concrete were removed at the cracks it was found that the crack extended through the whole thickness of the concrete. This experiment was based on the observation that cracks do not appear in compressed asphalte carriageways, and as the principal difference between the foundation in the footways and carriageways is the thickness of the concrete, it was assumed that it was the cause. The observation is, however, an incomplete one. In streets of light traffic the cracks do appear in the asphalte, as in Little Blenheim street, Chelsea, and elsewhere. In streets of heavy traffic the cracks in the concrete tear the asphalte as they slowly form, but the traffic welds the asphalte together again before they show on the surface. In footways of heavy traffic there are fewer cracks than in those of light traffic, for a similar reason. At Muswell Hill, Hornsey, the experiment of covering the whole of the area of the footway between Onslow Rise and Grosvenor Gardens with bituminous felt was tried. The felt was in 3-foot widths, and was laid longitudinally with butt joints. At a circular curb the pieces were necessarily somewhat patched. The result

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Statue of Luiz de Camoès: Lisbon. Portugal.
Victor Bastos Sc:

Statue of Võlta. Como Ital
P. Marchesi. Sc:

NATIONAL

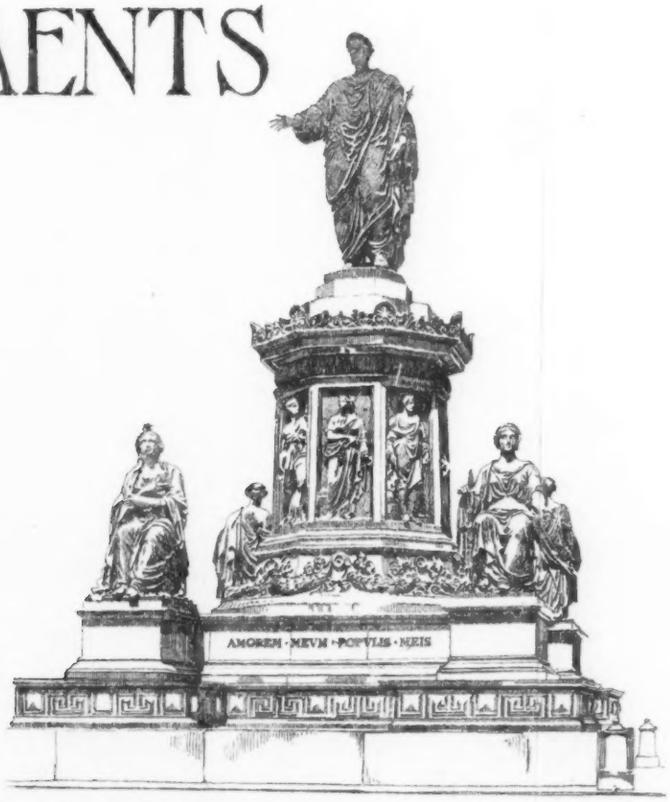
Statue of Christopher Columbus. Genoa.
Italy.

Statue of Admiral Tegetthoff: Vie
Carl Kundmann: Sc:

mo Italy
Sc:

National Monument at the Hague.
W. C. van der Pieterszen. Sc:

MONUMENTS



hoff: Vienna.
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Statue of Francis 1st Schonbrun
n: Vienna, Austria.
P. Marchesi. Sc:

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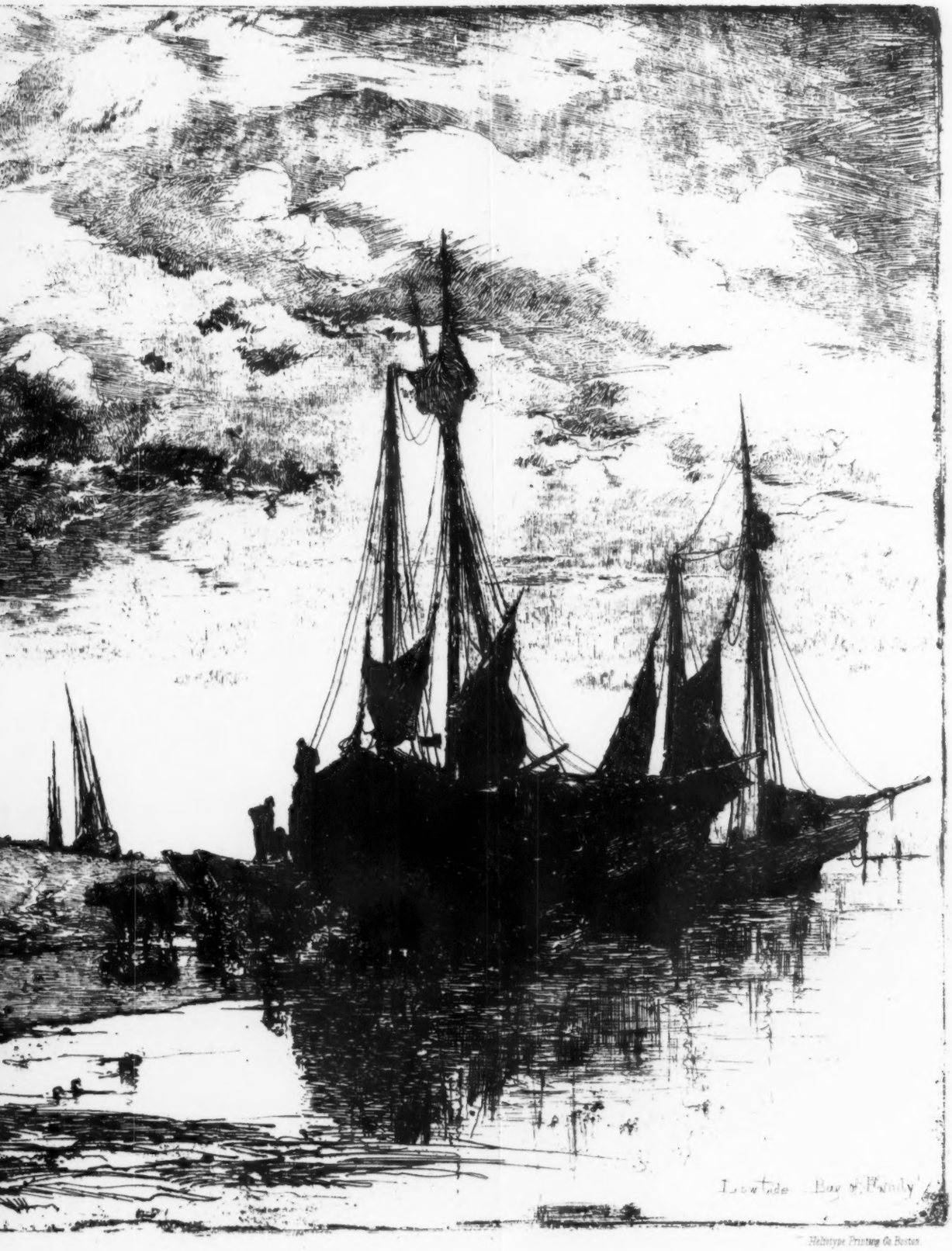

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Chateau, St. Germain-en-Laye. France.

has been that cracks have appeared at every joint of the felt with marvellous fidelity, owing to the movement of the concrete. In Whitehead's Grove, Chelsea, between Marlborough road and Keppel street on the north side, a length was laid in 1885 on a 3-inch concrete foundation, which was covered with mastic asphalte ¼ inch in thickness. On this, ¾ inch of compressed asphalte is laid. The mastic asphalte was laid to absorb by its elasticity the movement of the concrete without transmitting it to the compressed asphalte. It has survived two winters of great severity, and has lived twenty-one months without any cracks appearing. From this it would appear that the principle of a material between the concrete and the compressed asphalte which will absorb the effects of the movements of the concrete is a correct one, and the writer invites the members of the Association to experiment on cheapening the method. The present result is an increase of life of 33 per cent at an increase of cost of 12 per cent.

As evidence of the durability of compressed asphalte in footways, those in Cheapside may be named. They were laid in 1876 at a thickness of 1 inch, and are now wearing through. On the south side of the Strand, east of Wellington street, 1 inch of compressed asphalte was laid in 1881, and has had only the most trifling repairs. The streets in the City, with the heaviest foot traffic in the world, are paved with compressed asphalte on the footways.

The advantages of asphalte foot-pavements are durability, a smooth surface unbroken with joints, a good foothold, even and regular wear, their impervious character, and the readiness and neatness with which they are repaired. They have a sombre appearance, and show water on their surface longer than stone pavements. They wear to the last thickness without breaking up, and give a useful wear for the whole of their thickness. When a stone or other pavement has worn 1 inch it may not be half worn through, but its useful life is over. Where there are cellars under footways, asphalte as a material for footways is unrivalled. In ordinary traffic, such as those named in King's road (7000 to 8000 persons per day), an asphalte pavement 1 inch thick can be laid with the certainty that for at least ten years it will need no repairs whatever. This pavement has also the advantage that the foundation is always preserved and good for use again when the wearing surface of asphalte has to be renewed.

The following abstract of the present contract schedule in Chelsea will give the prices for these pavements: —

	℔ sq. yd. s.	d.
Compressed or mastic asphalte 1″ in thickness on 3″ of concrete	6	3
" " ¾″ thick	5	6
Compress'd asphalte ¾″ thick, on ½″ of mastic asphalte, laid on 3″ of concrete	7	0
" on mastic asphalte 1″ thick on existing concrete foundation (relay)	3	6
" on mastic asphalte ¾″ thick	3	0

These prices carry a guaranty of free maintenance for ten years. The Vestry prepares the foundation for the concrete in new work at a cost of 2d. per square yard. The specification provides that the asphalte will be cut open at distances not exceeding 50 feet apart, and the thickness measured. Five out of every six of these measurements must be at least the specified thickness, and the average of every six must be at least the specified thickness. The specification is strictly adhered to. The cost of the foot-pavement in New Bond street, already referred to, over twenty-six years, would be as follows at per square yard: —

	s.	d.
Preparing foundation	0	2
Laying concrete foundation and ½″ mastic asphalte	5	6
At end of 13 years relaying mastic asphalte (life 13 years)	3	0
Repairs	0	0
Total	8	8

or a cost per year, not including interest, of 4d. per square yard. It should be mentioned that the small cost of renewing asphalte footways is due to the fact that the asphalte taken up is as good as new asphalte after it has been cleaned and prepared, and is re-used for footways.

In dealing with the question of concrete as a material for foot-pavements, the writer cannot claim such an experience of it as he has had with asphalte. In 1880, however, the Vestry of Chelsea had laid by the respective makers a series of pavements in King's road against the Royal Military Asylum wall, and in 1885 a report was made on them by the writer.

Mr. Strachan went on to give a synopsis of this report, which is now out of print. In it he described the manufacture of the "Imperial Stone" pavements, of which a specimen piece was laid down in competition with other pavements in King's road, Chelsea. As to these trials of pavements, Mr. Strachan continued: —

In the King's road experimental pavements the makers laid their pavements with the knowledge that they were competing with their rivals. They were laid in 1880. Asphalte, York stone, Ferrumite stone, Victoria stone, and Imperial stone were laid side by side and subjected to the same traffic. The writer includes the York stone results, though not strictly coming within the subject of the paper.

In June, 1884, the Ferrumite stone was removed, as its slipperiness had become a source of danger. Its area was taken by Wilkinson's granite concrete pavement and by Sharp-stone pavement. After five years' wear of the original stones, the following results were obtained: —

The York stone occupied an area of 87 square yards; the original thickness was 3 inches; the number of stones 123, of which, after five years' wear, 10 had broken edges, 16 had broken corners, 21 had their surfaces peeling off, and six were worn so as to be dangerous. The wear was not measurable, by reason of the uneven thickness of the stones, but it was unmistakable. The foothold was good in all weathers. The actual cost was 8s. 7d. per square yard laid.

The Victoria stone occupied an area of 81½ square yards; the original thickness was 2 inches; the number of stones 168, of which thirty-five had broken edges and corners, two had their surfaces peeling off, and three were visibly cracked across. The wear was not quite ⅛ inch at the greatest traffic line. The joints of the stone were pleasing, and the color cheerful. The foothold is not so sure as that of York stone in dry weather, and in a drizzling rain it approaches slipperiness. The cost was 6s. 4d. per square yard laid.

The Imperial stone occupied an area of 90¼ square yards. The original thickness was a full 2⅛ inch; the number of stones, 187, of which eighteen had their corners and edges broken, and one had its surface partly peeled off. The wear was not quite ⅛ inch at the greatest traffic line. The regularity of the joints is pleasing to the eye, and the color is light and cheerful. The foothold is more sure than that of the Victoria stone sample, but it becomes somewhat slippery in drizzling rain. The cost was 6s. per square yard laid.

The experience gained with the Sharp-stone laid in 1884 is more limited, but the stone does not appear to be better than the concrete stones described. The length laid *in situ* by Messrs. Wilkinson is subject to the same remark, but the aggregate is already wearing up. It is laid in 8-foot bays. A repair made in it is a great blemish to it. The effect of the traffic in wear is visible.

Mr. Walker, of Leeds, has laid down (1886) in King's road, a short length, in bays of about 4 feet square. It has a very smooth surface, and appears to be a very good pavement. He lays a foundation of ballast concrete, 2½ inches thick, to within ½ inch of the finished surface, and cuts roughly through it so as to form the bays. He then floats the surface with fine rich concrete, made of one part of cement to one or one and a quarter part of crushed granite or slag which pass through a $\frac{1}{16}$ sieve. This is then cut through with a knife into bays of small areas. The foothold is fairly secure, and the wear very satisfactory. No cracks appear when the bays are made less than 10 feet square. At 322 Oxford Street, a piece has been down three years, and no wear is visible. He claims that his fine rich concrete on the surface attains more nearly to the texture of York stone than any other pavement. The joints, however, have a tendency to spread.

Concrete pavements laid in slabs have two serious disadvantages. The writer's experience refers to Victoria stone, but there is no reason to suppose that slabs of other make are free from them. The first is the annoyance caused by the hard metallic sound of the foot-fall on them, which is especially noticeable at night. The other is their brittle nature, and the presence of hidden cracks after wear. When taken up to relay, it is often found that a stone which was apparently sound, breaks before it can be relaid.

Concrete pavements *in situ* have the serious disadvantage that they cannot readily and cheaply be repaired. A patch in them shows for the whole life of the pavement, unless a whole bay is removed.

The writer is of opinion that concrete pavements *in situ* are preferable to concrete pavements laid as slabs. There is, however, no reason why this pavement should not be laid by surveyors themselves, without the aid of a contractor. Much has to be learned before concrete as a material for foot pavements is perfected, but that can most readily be learned by each engineer doing his own work, and exchanging experiences. The prices paid for concrete pavements are very great. One stone is advertised for 7d. per square foot, which equals 4l. 14s. 6d. a cubic yard. This is an extravagant price to pay for concrete, even if it be of the very best kind, and silicated too. Concrete for foot pavements has its own field, and within well-marked limits its use is advisable, but until its capabilities are more largely tried, and its usefulness increased, the full advantage will not be obtained from it. The price stated is large enough to cover the cost of experimenting, and the writer trusts that the members will carry out such a series of tests and trials as will complete the knowledge of concrete as a material for foot pavements.

THE ILLUSTRATIONS

[Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]

CHATEAU, ST. GERMAIN DE LIVET, NORMANDY, FRANCE.

[Gelatine Print, issued only with the Imperial and Gelatine Editions.]

THE NATIONAL LIBRARY, MEXICO, MEX.

FOR description see article elsewhere in this issue.

NATIONAL MONUMENTS. — III. — THE NATIONAL MONUMENT AT THE HAGUE, HOLLAND, DESIGNED BY W. C. VAN DER PIETERSZEN; MONUMENT TO VOLTA, COMO, ITALY. P. MARCHESI, SCULPTOR; MONUMENT TO ADMIRAL TEGETTHOFF, VIENNA, AUSTRIA, CARL KUNDMANN, SCULPTOR; MONUMENT TO COLUMBUS, GENOA, ITALY; MONUMENT TO FRANCIS I, SCHÖNBRUNN, AUSTRIA. P. MARCHESI, SCULPTOR; MONUMENT TO CAMOENS, LISBON, PORTUGAL. VICTOR BASTOS, SCULPTOR.

THE National Monument at The Hague (1863–9) commemorates the restoration of Dutch independence in 1813, and the return of William Frederick, Prince of Orange, here represented in his coronation robes upon one side of the pedestal. The crowning figure is Batavia; the seated figures upon either side represent Law and Liberty.

The Monument to Volta is national in the sense that he conferred honor not only on his birthplace but upon the whole kingdom.

The Monument to Admiral Tegetthoff is closely allied in intention and spirit to that which is at some time to commemorate Gen. Grant.

The Monument to Columbus was erected in 1862 and is entirely of marble. The seated figures represent Religion, Geography, Strength and Wisdom; the nude figure at the feet of Columbus is America; the bas-reliefs represent scenes from the life of the discoverer.

The Monument to Luiz de Camoes (Camoens) does honor to the author of the great Portuguese epic, the *Lusiad*.

THE BAY OF FUNDY. AFTER AN ETCHING BY MR. SAMUEL PARRISH, PHILADELPHIA, PA.

CHATEAU, ST. GERMAIN-EN-LAYE, FRANCE.

BUILDING MATERIALS.[1] — II.

A Design by Fragonard

From la Revue des Arts Decoratifs

THIS rusting or combination of iron with oxygen results from the exposure of iron to the combined action of air, moisture and carbonic acid. That moisture plays an important part in the oxidation of iron is proved by the fact that a piece of steel is rapidly corroded when exposed to the influence of a mixture of moist oxygen and carbonic acid, whilst but little, if any, effect is produced upon it by the dry gases. The influence exerted by the presence of carbonic acid is probably due to the tendency it would have to induce the formation of a carbonate of the protoxide of iron or ferrous-carbonate, which is subsequently converted into a hydrated-peroxide. It is well known that the tendency of two substances to combine with each other is increased by the presence of a third substance, which exhibits a powerful attraction for the compound resulting from their union. We have a familiar example of such action in the formation of saltpetre (potassium-nitrate), which takes place under favorable circumstances in soils containing potash and nitrogenous organic matter, the union of the nitrogen with the oxygen of the air to form nitric acid being promoted by the presence of a powerful base, such as potash, for which the acid has a strong affinity.

The advantages derived from the use of lime in agriculture are to some extent due to a similar cause, the beneficial effects resulting from the application of lime being most evident when it is applied to newly broken-up ground or soils containing a large quantity of vegetable matter, the decomposition of which is promoted by the presence of lime inducing the formation of organic acids with which it combines. The well-known protective influence which lime or any caustic alkali exerts in preserving iron from rust is to be attributed in a great measure to the absorption of carbonic acid. The coils of fine iron wire used in deep sea-soundings (any rusting of which would be of serious consequence) must necessarily, for obvious reasons, be put away whilst they are wet, and therefore under the most favorable conditions for rusting, but they are preserved by being stored in a solution of caustic soda. Lime is also very commonly employed for preserving articles made of iron. It is well known that when iron has once begun to rust its corrosion proceeds with increased rapidity. This may be due partly to the porosity of the oxide of iron formed, which causes it to absorb moist air more rapidly, but principally to the galvanic action arising from the porous oxide acting the part of an electro-negative element, and the metallic iron that of an electro-positive element, whilst the moisture absorbed performs the functions of the exciting liquid in the cell of a galvanic-battery. Hence we see that in order to preserve iron from being destroyed by rust, it is essential that every particle of rust should be removed as soon as it is formed, and that the smoother, brighter and more polished the surface of the iron can be maintained, the better will it be able to bear exposure to oxidizing influences.

Besides the serious effects produced by oxidation upon iron structures, which, of later years, have grown to such vast importance, the products resulting from the oxidation of iron possess a special interest in connection with the subject of stone, inasmuch as the oxides and other combinations of iron form the chief coloring matter of all rocks. In some cases, such as flints, which become white when calcined, the coloring matter is of a carbonaceous character; in other cases, the color may be due to manganese, chromium, copper, as well as other metals, but the presence of these is rare, as compared with the oxides and other compounds of iron which are almost always present, giving rise to a variety of colors, including black, blue, gray, green, as well as every shade from light yellow to a deep red. The hard kidney-shaped nodules which are found in the red hæmatite ore of Cumberland consist of pure anhydrous peroxide of iron, whilst the brown ores, such as those of Northamptonshire, consist of the hydrated oxide, and in the well-known magnetic iron ore of Sweden, we have the black oxide.

Black oxide of iron is produced when steam is passed over iron at a red heat, the vapor of water being, under these conditions, decomposed, the oxygen combining with the iron to form the black or magnetic oxide, and the hydrogen being evolved as gas. This reaction has been utilized as a means of obtaining hydrogen gas on a considerable scale for filling balloons, and also for producing a coating upon iron which will protect it from further oxidation. This method of preserving iron from rust was made the subject of a patent some years ago by the late Professor Barff, and the process has been successfully carried out with respect to articles that are capable of being subjected to a high temperature without injury.

The iron to be preserved, which must be clean and free from rust, is placed in a chamber which is heated to a temperature of from 1,000° to 1,200° Fahr. Steam is generated in a boiler under a pressure of about thirty pounds to the square inch, and superheated by passing through a series of wrought-iron pipes protected from the effects of the fire over which they are placed, by others of cast-iron. When the chamber is filled with the articles to be operated upon (which may consist of either wrought or cast iron), the door is closed and the temperature maintained chiefly by the steam admitted for a period of from three to five hours.

Another method of preserving iron from rust by means of a coating of this unalterable black oxide, has been patented by Mr. George Bower, which consists in passing the hot gases produced by the combustion of fuel over the iron, instead of steam, mixed with a proportion of air, which is increased or diminished according to whether an oxidizing or reducing effect is desired to be produced. If the iron be rusty, a reducing flame converts the red oxide into the black or magnetic oxide. In the case of wrought-iron that is not rusty, Mr. Bower prefers to produce in the first instance a little red oxide by increasing the quantity of air, as he finds that the black oxide finally produced is rendered thereby less liable to scale off.

Barff's process is best adapted for polished steel or wrought-iron; Bower's for cast-iron and rusty iron. The two processes are now combined, and frequently articles are subjected first to the heated gases produced by combustion and finished by superheated steam.

There can be no question as to the success of the process as regards the smaller description of iron goods, for when properly conducted, iron will bear exposure to the atmosphere under the most trying conditions without a particle of rust being produced, and if specks of rust should make their appearance on spots that may not have been thoroughly coated with the black oxide, the rust shows no tendency to spread. This process is specially adapted for intricate castings, as the gas penetrates the finest lines, producing a thoroughly protective coating. As a means of preparing articles for gilding, it has been of great assistance in overcoming the difficulty previously experienced in coating iron so as to prevent it from rusting, and as a necessary consequence throwing off the gilding. The unavoidable expense incurred in heating large masses of metal to the required temperature renders it difficult to apply a process of this kind to heavy castings, neither is it suitable for protecting wire, because the coating being of a brittle character, breaks off when the wire is bent, unless the coating is too thin to afford efficient protection to the wire. There is a difficulty in applying it successfully to nuts and

[1] A lecture by W. Y. Dent, F.C.S., F.I.C., read before the Society of Arts, and published in the *Journal* of the Society. Continued from page 88, No. 608.

screws on account of the oxide filling up the threads to such an extent as to prevent their working satisfactorily, neither can it be considered a suitable process for chains, the links of which, by friction against each other, soon rub off the coating of black oxide. The necessity of raising the iron to a red heat is also a bar to the use of this process in many cases in which otherwise it would be invaluable as a preventative of rust. The process ordinarily adopted for preserving iron from rust, termed "galvanizing," consists in immersing the iron in a bath of melted zinc, and thus covering the iron with a coating of zinc which rapidly oxidizes on the surface, but under ordinary circumstances the oxide formed remains firmly attached to the metal, and thus protects it from further corrosion. It has lately been proposed to deposit the zinc electrically upon the iron, a process which is said to be successfully carried out at a less cost than the ordinary galvanzing process.

The effects produced by carbonic acid are most strikingly exhibited in its solvent powers as regards the carbonate of lime, carbonate of magnesia and protoxide of iron. Many natural waters contain ferrous-carbonate in solution, more especially those known as chalybeate waters, and from such water, when exposed to the air, peroxide of iron is deposited by the oxidation of the ferrous-carbonate. The hard waters obtained from the chalk contain lime held in solution by carbonic acid, and the softening of such water by what is known as Clark's process, consists in adding just sufficient lime to neutralize the carbonic acid that holds the carbonate of lime in solution, when the whole of the lime existing as carbonate is precipitated, the water being softened down to about one-third of its original hardness, an immense advantage in water required for domestic purposes. It is the solvent action of carbonic acid upon carbonate of lime that gives rise to those magnificent incrustations that occur in the caverns of limestone rocks, such as are found at Clapham Cave in the north of Yorkshire, Castleton in Derbyshire and the Kitcraft Quarry in the Isle of Portland. These incrustations frequently take the form of icicles hanging from the roof, when they are known as stalactites, which are sometimes several feet in length. The pillar-like masses rising from the floor are termed stalagmites. These incrustations are produced by the rain-water, which, charged with carbonic acid, percolates the limestone beds, and dissolves in its progress the carbonate of lime. When the water saturated with carbonate of lime reaches the roof of a cavern and becomes exposed to the air, it loses some of its carbonic acid, and a particle of carbonate of lime is deposited, and when the drop reaches the floor, a further deposit of carbonate of lime takes place, owing to the escape of carbonic acid until, after the lapse of time, large masses of these deposits are accumulated. A very remarkable example of the formation of incrustations of this description during a comparatively short period of time, was discovered when widening the north bridge at Edinburgh connecting the old town with the new. Between the arches of the bridge and the roadway were a number of chambers or vaults varying in height, and from eight feet to ten feet in breadth, which had not been opened since the building of the bridge one hundred years before. From the vaulted-ceilings of these chambers (especially from the joints of the masonry) hung hundreds of delicate sparry crystals of snowy whiteness; many of these reached the floor, forming slender, thread-like pillars resembling a grove of brittle canes, some of these pillars being as much as six feet in length. A large number of little stalagmitic mounds, each surmounted by a short, slender stalk, were also observed, which were evidently the lower ends of what once had been continuous pillars. The bridge was built of sandstone, and this curious formation had been produced by water, which had trickled through the masonry, and had thus become saturated with carbonate of lime from the mortar in the joints.

The solubility of carbonate of lime in water charged with carbonic acid not only gives rise to these very remarkable and curious incrustations, but exerts a very considerable influence upon geological limestone formations, the insoluble carbonate of lime being deposited as a sedimentary rock. The white concretionary limestone, known as travertin, of which both ancient and modern Rome are largely built, is an example of such a deposit which is taking place in some parts of Tuscany at the rate of six inches a year. Carbonate of lime being deposited from its solution in carbonic acid, serves to bind together other materials with which it comes in contact in the course of such deposition; it thus serves as the binding material of several varities of building stone, and becomes an important agent in the formation of rocks. An excellent example of such formation is to be seen at Bermuda. The islands are surrounded by immense beds of calcareous sand, to the extent of twenty miles, resulting from the disintegration and breaking up of the coral-reefs which abound in that part of the world. This sand is washed up by the sea, caught by the prevailing winds, and blown up into hills forty feet or fifty feet in height; the rain falling upon these calcareous deposits dissolves out from the upper portions carbonate of lime, which is again deposited as the water percolates the drift, and binds together the particles of sand, as well as other *débris* into a coherent mass which gradually hardens into a rock.

Under normal conditions of the atmosphere, the agents which tend to alter and decompose whatever is subjected to their influence, are few in number and comparatively slow in their action; deriving the enormous power they exert from the persistency of such action through long periods of time; but this can hardly be said to be the case as regards the atmosphere of our large towns, and especially of those in which extensive manufacturing operations of various kinds are carried on. The air of such towns becomes charged with substances of a much more deleterious and corrosive character than those which I have described as belonging to the atmosphere in its normal condition. In the neighborhood of alkali works, potteries and other manufactories where large quantities of common salt are decomposed, the air is liable to contain appreciable quantities of hydrochloric acid, although the amount of this highly corrosive mineral-acid that is now allowed to escape into the air is very much less than was formerly the case before the Alkali Act was passed, which enforces the condensation of all acid-fumes as far as practicable. The sulphuric acid, either in a free or combined state, existing in the air of towns, is of more serious consequence than the hydrochloric, not only on account of its existing in much larger quantities, but because it is derived, in a great measure, from the sulphur contained in the coal burnt for domestic as well as other ordinary purposes, so that no extension of the Alkali Act could relieve us from this impurity. The total consumption of coal in all large towns is enormous, and when we consider that the greater part of this coal contains from a half to two per cent of sulphur, we must see what a vast quantity of sulphuric acid is likely to be produced from this source. Taking the average quantity of sulphur in coal as amounting to one per cent, we have one ton, or 2,240 pounds, yielding twenty-two pounds of sulphur, which, by absorption of oxygen, is capable of producing sixty-seven pounds of oil of vitriol. The late Dr. Angus Smith, who for several years carried out a long series of investigations on the impurities existing in the air of large towns, found the air in some parts of Manchester to contain as much as from 800 to 1,200 grains of sulphuric acid (either in a free or combined state) in every 1,000,000 cubic feet, and from 100 to 150 grains of hydrochloric acid either as such, or as chlorides. The presence of this large amount of acid matter existing in the air was corroborated by the quantity found in rain-water; the mean result of a vast number of experiments, conducted through a whole year, gave an average of from three to four grains of these acids, either in a free or combined state, in an imperial gallon. In parts of London where coal is consumed chiefly for domestic purposes, 730 grains of sulphuric acid, either as such or in combination, was found in 1,000,000 cubic-feet of air. To whatever extent these acids may be neutralized by combination with the ammonia, or other alkaline matter with which they came in contact, there can be no question but that the sulphuric acid (either in a free or combined state) existing in the air of towns is very detrimental to many descriptions of stone, and altogether precludes the use of such a material as Caen stone for the exterior of buildings which are so situated as to be liable to be exposed to its influence. On examining the crumbling surface of Caen stone from buildings in large towns, it has been found that the decayed portions of this stone contain a considerable quantity of sulphate of lime. Dr. Angus Smith found mortar in Manchester in which the lime had been to a large extent converted into sulphate, and on examining the black deposit which collects in the hollow spaces between the stones on the walls of St. Paul's Cathedral, I found it to consist of particles of sand and other *débris* (which no doubt had greatly assisted in producing abrasion of the surface of the stone), soot, together with a very large quantity of sulphate of lime. When this crust remains firmly attached to the stone the policy of removing it may be questionable, as it probably serves to protect the surface of the stone from further action.

The amount of acidity acquired by rain in large manufacturing towns is sufficient to cause it to act rapidly upon galvanized-iron roofs unless protected by paint. The zinc oxide which under ordinary circumstances remains attached to the metal is readily attacked by weak acids, and if subjected to the action of acid rain, the zinc coating is rapidly destroyed, and the surface of the iron is exposed.

It has been proposed to use iron covered with lead for corrugated roofs, which are subjected to the influence of a smoky atmosphere as being less easily attacked than the zinc. In galvanizing, the iron simply requires to be immersed in a bath of melted zinc, but lead will not attach itself to iron under similar stated circumstances. This difficulty is stated, however, to be overcome by mixing with the lead small quantities of phosphorus and arsenic. This method of coating iron was made the subject of a patent in America, and in England, three years ago. Having considered the nature of the influences to which stone is liable to be exposed which tend to promote its destruction, let us now turn our attention to the chemical composition and physical structure of the various descriptions of stone used for building purposes, and their relative capability of resisting exposure to such influences as have been described. Of these a block of hard and compact well-polished granite is unquestionably one of the most durable. To be hewn out of the solid rock has in every age been regarded as typical of endurance, and the word granite is so associated in our minds with all that is lasting and permanent, that to speak of any building as being constructed of granite is considered to be a guaranty of its strength and durability. The term granite is understood by geologists to indicate a rock consisting of quartz, felspar and mica in a crystalline granular condition, which may be associated to a greater or less extent with other minerals, such as hornblende, talc, schorl, etc., which give rise to a number of rocks differing in their composition and character, and distinguished from each other by various names, derived either from that of the prevailing constituent or from the localities in which they were first known. Thus we have talcose granite, in which the quartz, felspar

and mica are associated with talc; hornblende, or syenite-granite, in which the mica is more or less replaced by hornblende. The word syenite, derived from Syene in Egypt, whence was first obtained the beautiful material so largely used by the Egytians for obelisks and other architectural purposes, has been hitherto understood to represent a granite in which the mica has been replaced by hornblende, but this term is now restricted by geologists to a rock consisting of a crystalline granular mixture of orthoclase and hornblende.

Of the three constituents of typical granite, quartz offers the greatest resistance to any weathering action. When it exists in the form of hard colorless crystals (commonly known as rock crystal) it is pure silica. The crystals, however, frequently assume various shades of color, according to which they have received appropriate names, such as rose quartz, milk quartz, the amber-colored crystals being known as cairngorm stones, from having been found in the Cairngorm Mountains of Aberdeenshire. Silica in this highly crystalline condition resists the action of almost every chemical reagent with the exception of hydrofluoric acid, but it can be made to combine with an alkali by the assistance of heat. Felspar, as represented by the mineral orthoclase, consists of silica, alumina and potash, and of silica, alumina and soda, as represented by the lighter colored mineral albite. Lime also enters into the composition of some felspars, such as oligoclase, which contains two per cent of lime, and labradorite, which contains from ten to twelve per cent, this last being an opalescent felspar, exhibiting a peculiar iridescent display of colors when the light falls upon it in certain directions.

Mica, so named from its being easily divided into glistening scales, consists of silica and alumina, associated with magnesia, soda and lime, in varying proportions; thus we have potash mica, consisting of silica, alumina and potash; and magnesia mica, in which the alumina is partially replaced by magnesia, passing (as the proportion of magnesia increases) into soft talc, which is chiefly composed of silica and magnesia.

The term granite, as commonly employed, is used in a much more comprehensive sense than belongs to it legitimately as understood by geologists, for under this general term are included many hard crystalline rocks which differ in their composition from true granite; the so-called granites of Leicestershire, Guernsey and Jersey, as well as that of the Malvern Hills, partaking more or less of the character of syenite.

The several descriptions of granite differ materially from each other, both as regards their composition and physical structure; whilst those which are well crystallized are extremely durable, there are some granite deposits which possess but little cohesion, and readily yield to the influence of atmospheric changes. In several districts examples of granite of this latter description are to be found, but there are none so remarkable as those which exist in Cornwall, where some of these granitic deposits are in such a friable condition that a slight blow is sufficient to make the mass fall to pieces, forming the deposit known by the name of china-stone, whilst in other parts, the decomposition of the felspar of the granite has proceeded to such an extent that the deposits have become converted into china-clay or kaolin, so named from two Chinese words signifying a high ridge. The natural china-clay contains crystals of quartz and flakes of mica, with sometimes a little schorl and undecomposed felspar; it is covered by a layer of sand, stones and impure discolored clay, varying from thirty to forty feet in thickness, which it is necessary to remove before the clay can be worked. The broken up clay is exposed to the action of a stream of water, which, carrying off the finer portions in suspension, is led through long channels (in which the sand and rougher particles are deposited) into large pits from thirty to forty feet in diameter, and from seven to ten feet in depth, in which a further deposit of the heavier particles takes place; it is finally conducted into tanks in which the fine clay held in suspension by the water is allowed to deposit, the effluent water being sometimes collected in reservoirs to be used over again. The clay, which is of the consistency of soft mud, is removed from the tanks to the drying-floors, which are formed of fire-clay tiles heated by flues. It is spread upon these floors to a thickness of from six to nine inches, and when dry constitutes the kaolin or china-clay of commerce, as supplied for the manufacture of porcelain, and other purposes. This china-clay is prepared on an extensive scale, the larger works turning out as much as from 3,000 to 8,000 tons per annum. The first china or "hard" porcelain (by which is meant a porcelain capable of bearing a high temperature without fusion) made in Europe was that manufactured at Plymouth by Mr. Cookworthy, who discovered this clay at St. Stephen's, in Cornwall, in 1755. The clay is largely used as a dressing for calico, by paper-makers to give body and weight to their goods, and in the manufacture of ultramarine blue. Extensive deposits of this clay exist in China, America, in the north of France and in the Island of Bornholm, which supplies the clay required by Sweden, Denmark and the north of Germany.

The constituent of granite that is generally the first to undergo decomposition is the felspar, although there are cases in which the felspar stands out in sharp well-defined crystals, exhibiting quite as little tendency to decay as the other portions of the rock. In decomposing, the crystals lose their lustre, and as the disintegration proceeds, the potash and soda are washed away as soluble salts (for the most part as carbonates), leaving a hydrated silicate of alumina constituting the kaolin that remains. Experiments have been made which show that under favorable circumstances carbonic acid exerts an appreciable amount of action upon a variety of minerals, such as hornblende, serpentine, or apatite, and that this action is augmented by increased pressure.

With respect to the origin of the enormous deposits of crumbling granite, such as those found in Devonshire and Cornwall (covering as they do a large area of ground, and having in some places a depth of more than 100 feet), no very satisfactory explanation can be given. The clay in some cases rests upon granite of the hardest description, and it is the opinion of the best authorities that these deposits have either never been properly consolidated, or that they are the results of surface-decomposition which have been swept by the action of water into the spots which they now occupy.

In selecting stone for building purposes, too much attention cannot be paid to its physical structure, inasmuch as whatever may be its composition, stone which is of a hard, dense, crystalline character is not only capable of resisting more effectually the action of erosive agents when in actual contact with them, but is not exposed to the same amount of contact as is the case with stone of a more porous character, for when rain falls upon a close, polished surface it cannot sink into the stone, and consequently any matter of a corrosive nature with which it may be charged does not remain in contact with the stone for any length of time, but is carried off before it has had an opportunity of exercising an injurious effect. It is obvious that the more crystalline and compact is the character of the stone, the more capable it is likely to be of resisting the effects ordinarily produced by exposure to atmospheric influences, whether such may be of a normal description, or whether they may be of a more powerfully corrosive nature. It is to its physical structure alone that marble (which consists of carbonate of lime) owes its durability; its highly crystalline character rendering it sometimes capable of being favorably compared with granite, as is the case in some of the churches of Devonshire erected from 400 to 500 years ago, in which the marble shows fewer signs of alteration than the granite.

The importance of crystalline structure, as affecting the durability of stone, appears to have been recognized from a very remote period. Whoever the constructors of the great pyramid may have been, and whatever purpose they had in view in carrying on a work involving such an enormous amount of labor, it is quite certain that they must have been proficients in the art of building in stone. They appear to have exhibited much skill in its selection, and were acquainted with the best methods of dealing with large blocks, fully appreciating the advantages to be derived from fitting such blocks as closely together as possible with very thin joints. The celebrated red porphyry of Egypt, which derived its name from its purple color, was hard enough to be capable of taking a fine polish, and was largely used by the Egyptians, and subsequently by the Romans, for statuary purposes. It was upon a circular slab of this material, now at St. Peter's at Rome, that the Roman emperors were crowned. Columns of porphyry, after the lapse of 1,900 years, still exist which retain their freshness of color. The term porphyry is now applied to any rock having distinct crystals embedded in a felspathic matrix, and is used to designate the crystalline character of a rock. We have thus quartz porphyry, porphyritic granite, porphyritic greenstone. Cornwall is especially rich in these porphyritic rocks, a very excellent material, capable of taking a high polish, being obtained from the neighborhood of Bodmin. It was a schorlaceous variety of this description which is found on the surface in immense boulders near Luxullian, and hence known as luxulliante, that was selected for the sarcophagus of the late Duke of Wellington in St. Paul's Cathedral. The very perfect condition in which works of art of such great antiquity as those of Egypt have been found, is no doubt mainly due to the dryness of the climate of Egypt, but still, in part, to the excellent quality of the material employed. The syenite granite of Egypt was extensively worked as far back as 1,300 years B. C., the quarries whence it was obtained occupying an extensive tract of land between the first cataract of the Nile and the town of Assouan, which now stands near the site of the ancient Syene.

The famous Egyptian obelisks, one of which, known as Cleopatra's Needle, originally erected at Heliopolis (the "On" mentioned in the book of Genesis) about 1800 B. C., and now standing on the Thames Embankment, were obtained from these quarries. The obelisk at Rome was also one of those that stood in front of the Temple of the Sun, where it is said to have remained for 2,000 years before it was removed to Rome by Cæsar Augustus after the battle of Actium.

It is somewhat remarkable that the neighborhood of this ancient Syene, which for thousands of years had been the frontier town dividing Egypt from Nubia, should now in this nineteenth century be the site of explorations which are creating so much interest. On examining the sandstone hill on the west bank of the Nile, the removal of the sand led to the discovery, in 1885–1886, of a series of tombs where the nobles and chiefs of ancient Syene had been buried, containing inscriptions which indicate that the hill had been used as a cemetery as far back as 3000 B. C. From these inscriptions much interesting information is to be gathered of the manners and customs prevailing at the remote period to which they allude, some of them being of great historical interest. The freshness of the paintings on some of the shrines is surprising, and the colors are wonderfully true to nature. The hieroglyphs for granite hills are good representation of granite, and that of an elephant is painted in a grayish sepia the exact color of the animal.

THE EXCAVATIONS AT SICYON.

Pompey's Pillar.

MR. W. J. McMURTRY sends to the New York *Evening Post* the following description of the discoveries at Sicyon: Many of your readers are aware that, during the past spring, excavations upon the site of the ancient Greek city of Sicyon have been carried on under the auspices of the American School of Classical Studies at Athens. As a student of the school, and one who had immediate charge of this work, I send you a brief account of these excavations, believing that it will be of interest to all friends of Greek learning and archæology.

Sicyon is the second classical site upon which the American School has made excavations. Its selection was justified by its importance, especially in the history of Greek art, and by the fact that no systematic excavations had ever been made there. It was situated a few miles westward of Corinth, about two miles from the Corinthian Gulf. Writers on Greek history and geography become enthusiastic in describing the situation and surroundings of the city. It lay upon a large, level plateau, at the foot of which a plain of great fertility extends down to the blue, sparkling waters of the gulf. Across this rise the peaks of Helicon and Parnassus. On the east the plain is bounded by the bold mass of Acrocorinthus. The landscape is exceedingly beautiful; and Curtius and other writers are, no doubt, right in supposing that to the exceptional charm of its natural surroundings must be attributed a part of the influences which make Sicyon so famous a home of the arts.

Numerous ruins still exist upon the site, consisting of the theatre, the stadium, considerable remains of a large brick structure (probably Roman baths), many foundations of buildings, aqueducts cut in the rock, and traces of streets. There are extensive remains of the wall surrounding the acropolis, which was constructed by Dematrius Poliorcetes. Fragments of the columns also are found in and about the churches of the modern village of Vasiliká. It was thought best to confine our work mainly to the theatre. Our chief object was to discover its complete plan; but at the same time we propose to do some digging on the foundations of other buildings, since we desired to identify, if possible, some of these structures with the temples or other buildings mentioned by Pausanias in his account of the city, and hoped also to find some artistic remains. But we accomplished little of importance outside of the theatre, finding no inscriptions, and only a piece of marble upon which were the toes of a statue, and an Ionic capital of ordinary stone. The results of our work in connection with the theatre, however, are of great archæological value. It was one of the largest in Greece; the plan of its structure can now, for the first time, be studied. Dr. Dörpfeld, the distinguished architect of the German Institute at Athens, who has suggested new theories on the structure of Greek theatres, has shown the greatest interest in the results of its excavation.

The plateau upon which Sicyon lay is separated by a rocky declivity into two portions, a larger one nearer the gulf and a smaller one in the rear. The theatre was cut out of this rocky declivity. When we began our excavations there were to be seen slight traces of the stage, foundations of the stone seats, and two large arches, one on each side of the cavea, leading from the outside to the higher rows of seats. Over the orchestra was a layer of earth from three to nine feet deep. I will very briefly describe what may be seen now. There are three main walls belonging to the stage foundations. The one nearest the orchestra is about seventy-two feet long and three feet high. At its foot, in front, an ornamental marble border extends nearly its entire length. The blocks composing this border have at the ends the masons' marks, in the form of Greek letters. Upon one of them is one of the inscriptions that we found. This front wall has three doors in it, the middle one being double. It is evidently of Roman construction, being composed of not very large blocks of stone, and having bricks built into it. The second wall is of a different character from the first. It is made of large blocks of stone, well laid, and is, without doubt, of Greek construction. Its length is about forty-eight feet; its height the same as that of the first wall. It has in it only one door. The third wall is of mixed construction, part being like the first one and part like the second. It has the same length and height as the second wall. In it are two doors. At the distance of about twenty-one feet from the east end of the stage, a cross-wall extends between the second and third walls at right angles to them.

To determine the form of the orchestra, we dug a trench, which laid bare its boundary. It has an elliptical form; but the ellipse is not a complete one. Along half the circumference of the orchestra we dug far enough upward from the orchestra-boundary to lay bare five rows of seats. There are fourteen stairways extending upward from the orchestra, dividing the seats into fifteen divisions, or *kerkides*, as the Greeks called them. The seats are cut out of the rock. The front row is of more elaborate construction than the rest, each seat having a back and arms. These better seats, however, are not of marble, but of the same ordinary stone as the others. Probably priests and other dignitaries sat in these seats, as in the marble chairs of the Dionysiac Theatre at Athens.

The drainage system of the theatre seems to have been elaborate. A deep drain extends around the orchestra to the entrances, having stone bridges opposite the stairways, precisely as in the theatre at Athens. An aqueduct passes from the centre of the orchestra to the stage, and out under the middle door of the first wall. Another extends from the western side of the orchestra to the one just mentioned. In various places earthen pipes were found, which evidently served as drains.

I have already mentioned two arches, which afforded entrance and exit to the people in the higher rows of seats. These arches are interesting, as adding another to the very rare examples of Hellenic arches. The old theory that the Greeks did not construct arches until after they came under Roman influence must be abandoned. Another arch of Hellenic construction was found by the Germans at Olympia. That the arches at Sicyon are not Roman is manifest from their construction. There is in them no trace of mortar or brick. In the dimensions of the blocks and the manner of laying them, the arches are exactly like the portions of the stage walls that must be attributed to the Greeks.

In addition to the three main walls of the stage-structure we found two others in the rear running parallel to them. Both these walls seem to be of Roman construction. A portion of a column, apparently *in situ*, upon the outer wall would seem to indicate that it was the foundation-wall of a colonnade adorning the front of the theatre.

In following up the wall last mentioned we found a structure, the nature of which is obscure, though it seems to have been a fountain of somewhat elaborate construction. In front are portions of four columns, still in position. These columns are channelled only upon the outer side. Back of the columns, at a distance of about three feet, is a semi-circular enclosure, with plastered walls and a smooth floor. A semi-circular mass projects in front of the rear wall. A great number of fragments of tiles found within would seem to indicate that the structure was roofed. Both in the front wall, forming the diameter of the semicircle, and in the rear curved wall, are orifices, apparently for the passage of water. On the west side is a well-constructed trough having a back like a seat. This trough was probably for the use of horses. At this fountain, also, earthen water-pipes were found. Here our last digging was done. Some traces of other foundations appeared, and further digging at this point would probably not be fruitless.

The artistic remains which we found are not of very great value. The most important are: The arm of a statue of more than life-size; a piece of the leg of another statue; the lower part of a draped statue. These were found in the earth covering the stage. We found numerous architectural fragments, among others an Ionic epistyle of common stone, a Doric epistyle of marble, pieces of Ionic and Doric capitals, and of lion-headed water-spouts. Some fragments bore traces of blue and red paint. We found numerous copper coins having upon them the dove, the well-known symbol of Sicyon. We found also a number of small earthen lamps. We discovered only two inscriptions, one of the Roman period, incomplete, relating to honors to be bestowed upon certain ambassadors; the other of the Alexandrian period, recording the victories gained in various games by one Callistratos, the son of Philothales.

A detailed report of the work done at Sicyon, accompanied by a plan of the theatre, and illustrations, will appear in the volume of papers of the American School for the present year.

SOCIETIES

THE ANNUAL CONVENTION A. I. A.

THE following information concerning the annual convention of the American Institute of Architects has just reached us from the official sources:

IN BOARD OF TRUSTEES, A. I. A., June 15, 1887.

"The question of arrangements for the next annual convention of the Institute being in order, the Secretary and Mr. Littell, of the Board of Trustees, and Messrs. Jenney and Gay, of Chicago, were appointed a Committee of Arrangements therefor, and it was resolved that, in accordance with the invitation received last year, through M. Root, President of the W. A. A., the said convention should be held in Chicago, at a date, preferably in October, to be fixed by said committee."

August 10, 1887.

—— Esq. *President*
—— " *Secretary* } —— Chapter A. I. A.

Dear Sir, — Referring to the approaching Twenty-first Convention of the A. I. A., to be held in Chicago, permit me to call your attention to the enclosed copy of circular letter, and to ask you to fill in the blank and let me know the name of some member of your Chapter who would be likely to respond with a paper on the kind of structure chosen for treatment.

I would also suggest that another member of your Chapter be selected to prepare some condensed "suggestions towards the best and speediest methods for harmonizing and utilizing all the architectural societies in the United States, so as to secure the most good for

architecture, for the public, and for the profession in America — due regard being had, as concerns means, alike to individual energy and enthusiasm, and to associative experience; and, as concerns ends, alike to local sentiment, and to national reputation."

And if you think it compatible with the interprofessional relations and other conditions of your locality, I beg, moreover, to suggest that still another member might be selected to prepare a brief résumé of the high-class architectural work lately executed in your neighborhood. Or, if preferred, the secretary of your Chapter might embody this in his annual report to the Institute.

As the make-up of the programme will depend on the information received in regard to the above-mentioned points, an early answer is particularly requested. Yours respectfully, A. J. Bloor, *Sec'y.*

For Messrs. W. L. B. Jenney, E. T. Littell, H. L. Gay and myself, Committee of Arrangements Twenty-first Convention A. I. A.

August 10, 1887.

Dear Sirs, — Desiring to make the approaching Twenty-first Convention of the Institute an interesting one, I beg to ask you to prepare, if at all consistent with your engagements, a short paper on "The paramount requirements of a large [blank to be filled in with generic name of structure], as regards site, construction, disposition of space, arrangements for water-supply, day and night illumination, ingress and exit, heating, ventilation, hygiene generally, and provision against conflagration; as well as any other points involved in this special theme which your studies and experience have lead you to class as important."

As style is generally conceded to be a matter of taste, chiefly dependent on education or temperament, environment or fashion, or on a combination of these. I have not included it under paramount requirements; but it is, nevertheless, the crowning element of an edifice in its relations with the contemporary public (outside of its occupants and habitués), and with posterity and history; and, if you think it best to enter such a wide field of your subject, the Convention will doubtless be very glad to hear what a fellow-specialist of your prominence may desire to say on it.

The paper should be as brief as possible, to allow time for the reading of other papers, and for the discussion of all, as well as for the usual large amount of routine work. It need not be delivered to the Secretary before October 1st ensuing, but, if you accept the obligation I have the honor to propose to you, a speedy answer is requested, as the programme of the Convention must be published shortly.

Yours respectfully, A. J. Bloor, *Secretary.*

COMMUNICATIONS.

CEMENT-STUCCO WORK.

To the Editors of the American Architect: —

Dear Sirs, — I have done some work in cement-stucco over rough brick wall, which proves very unsatisfactory in color, being mottled, etc. I cannot paint it, because the cement would eat through the paint. Can you suggest any treatment that will produce an even, uniform and permanent tone of color?

Respectfully yours, A. B. Jennings.

[If the character of the work admits, perhaps the safest way would be to cover the stucco-surface with rough-cast of lime and gravel, which may be colored with ochre, Venetian-red, or other mineral colors; or the stucco may be treated with acid. — Eds. American Architect.]

MORE BRIBERY,

Boston, August 15, 1887.

To the Editors of the American Architect: —

Dear Sirs, — The following "complimentary" communication is now being sent to architects by the well-known firm whose name it bears:

Compliments of
Joel Goldthwait & Co.
We are now showing our European Specialties
for the Fall Season.

Special inducements offered for your influence in placing these goods with your clients. Personal interviews solicited.

The compliment, no doubt, is contained in the frank assumption of the final clause that the influence of architects may be secured by "special inducements," the nature of which may be more clearly stated during the "personal interviews" which are solicited.

Yours, with respect, Horace G. Wadlin.

[As Messrs. Joel Goldthwait & Co. have thought it not best to give any answer to a polite note we addressed to them asking for information as to the "special inducements" they offer to architects, there is obviously no other inference to be drawn than that they know they are doing something of which they have reason to be ashamed. As the firm is given by the commercial agencies a large capital and the highest credit, it would seem as if it might content itself with gathering wealth in legitimate ways without descending to the use of bribery and corruption. The incident exhibits clearly how wide is the difference between the "highest commercial integrity" and what those outside of business circles understand by uprightness and honorable action. — Eds. American Architect.]

NOTES AND CLIPPINGS.

A Bronze Buffalo Head. — The largest bronze casting ever made in America — a buffalo head, designed by Kemeys, the sculptor, for the stone arch which constitutes the east portal of the new Union Pacific bridge across the Missouri at Omaha — was cast last week. The head measures 9 by 5 feet, and the box containing the sand and plaster mould was 22 × 22 × 26 feet. Some 4,500 pounds of molten bronze were poured into it. — *Engineering News.*

Providence Sewage System. — The plan proposed by Mr. Samuel M. Gray for the disposal of the Providence, R. I., sewage, and the purification of the waters bordering on the city, has been formally adopted by the City Council. This means the impounding of the sewage at Fields's Point, 14 feet below city datum, there to be lifted 28 feet by pumps, then chemically treated, and the effluent discharged into the river. Thus Providence, like Boston, takes a radical step in the direction of its sewage-disposal, and sets an example to other American cities which are in like manner troubled, but still remain content with makeshifts rather than grasp the subject in the intelligent and satisfactory manner that has characterized the work of Mr. Gray and his associates at Providence. — *Engineering News.*

The Exhibition of 1879. — The works on the Champ de Mars for the Exhibition of 1889 are going on apace. The foundations for several of the large buildings have been laid, and the modern Tower of Babel, which is being constructed under the auspices of M. Eiffel, is gradually rising from the ground. M. Eiffel hopes that it will be quite finished by October next year. The first story, about 180 feet in height, will, in all probability, be completed at the end of December, and we shall then be able to form a fair conception of the character of the entire structure. Curiously enough, the workmen engaged in clearing the centre of the Champ de Mars have met with unexpected difficulties, owing to the fact that portions of the old exhibition buildings had not been properly removed. They have been obliged to have recourse to blasting. I hear, by the way, that most of the men, about 600 in number are employed at the rate of 2½*d.* to 3*d.* per hour. These are low wages for Paris, but the behavior of the laborers has been excellent, and their zeal and activity have already won for them no small amount of commendation. — *London Daily Telegraph.*

TRADE SURVEYS.

A false alarm has been raised in financial circles relative to the sufficiency of money for business requirements. Less money is seeking speculative channels, and more is finding its way into legitimate channels. The business interests owe less money than ever for the volume of business done. Railroad companies and builders in many lines are heavy borrowers, but the rate of interest is low, long-time loans are made, the properties concerned are likely to be productive at an early date, and will enjoy a large business. In short, the foundations are strong, and it will be impossible to create much alarm among the men who are broadening the industries and commerce of the country. A very moderate percentage of railroad capital has fallen into receiver's or sheriff's hands. Very little of the new mileage is in advance of the time. Railroad-building requirements are still the chief factor in trade, and help more than any other to preserve the steadiness of values. Since July 1st prices for all leading products have remained almost stationary. This is encouraging in view of the expansion of facilities. Since that date no less than a dozen large sea-going vessels have been placed under contract, more than two hundred locomotive-engines, four thousand freight-cars, a large river and lake tonnage, the details of which it is impossible to tabulate, and a vast amount of general business has been done which leaves the industries, from the greatest to the smallest, in better shape than on July 1. The lumber manufacturers are entering on a fall lumber demand with a full stock. Yellow pine is in larger supply at Southern points than a year ago. Cypress and sap are being manufactured in larger quantities. The entire list of hardwoods is strong, and the supply has been materially increased in all Atlantic coast markets. In fact, in one or two cities besides Boston the supply is a little in excess of demand. White pine is also abundant, but the overplus is held in the West under strong control. The sash and door interests complain of low prices. Saw-mill interests apprehend a slight cessation of activity. Makers of wood-working machinery report, in some sections, a slacking of demand, though the larger concerns, like those at Cincinnati, make no complaints as to dulness. The Western manufacturers of foundry products, tools, machine-shop equipments, implements large and small, after a very busy spring and summer are now obliged to run full time to fill orders. The textile interests throughout New England are quite busy at a number of points. Canadian labor is returning from a two to six weeks' stay, and, in consequence, quite a number of looms and wheels are idle. The makers of electrical appliances are especially busy. The manufacturers of American articles for export have extended their markets abroad for many products, and the European and British continental markets are being worked with renewed zeal.

Coming back to the iron industry, it is found to be in excellent condition. There are no indications of a falling off in demand in any quarter. Taking business in general, the volume is heavy. Bank clearings indicate activity and health. Failures are few. Collections are good. Bad debts amount to but a trifling percentage. New orders are coming in earlier than usual. Travelling agents so far have met with success. The distribution of merchandise over store counters has been good, and the low condition of stocks gives assurance that the autumn trade will be up to all the sanguine anticipations indulged in concerning it. Builders are busy. Permits and new operations increase. Building-material is cheap. Alterations and repairs are absorbing at least double the amount of money expended for such purposes in any former year. The upward tendency in land values seems to have been checked. A vast amount of city property all over this country is being changed from domestic to business purposes, as well as for manufacturing requirements. The progress made is safe and healthful, and the wealth-producers have every reason to feel proud of their conservative management in all directions.